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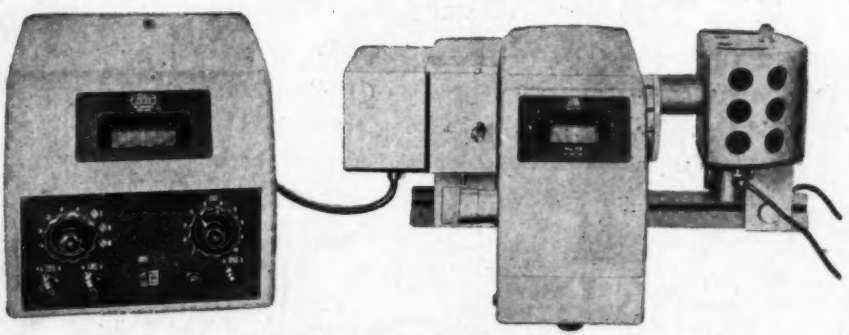

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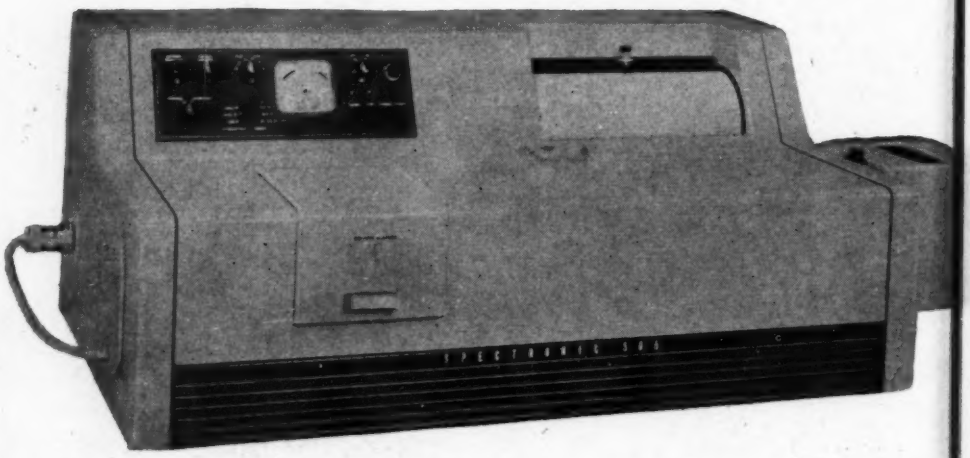

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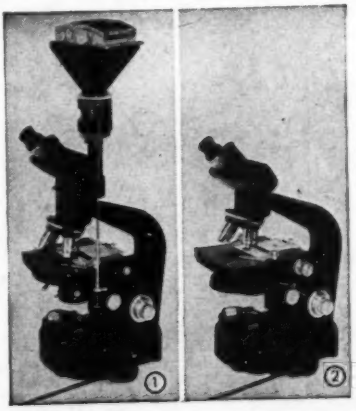

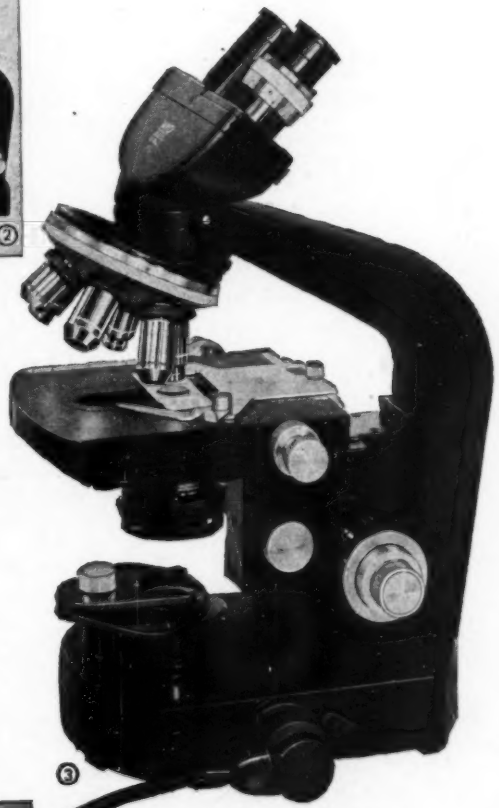

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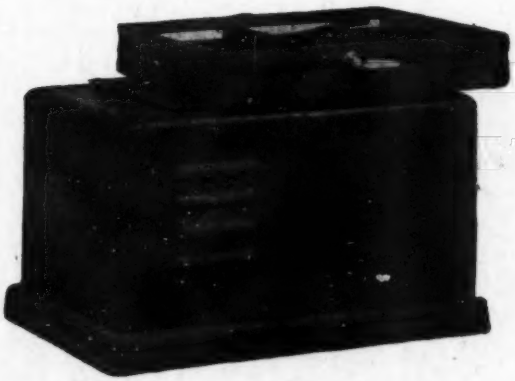

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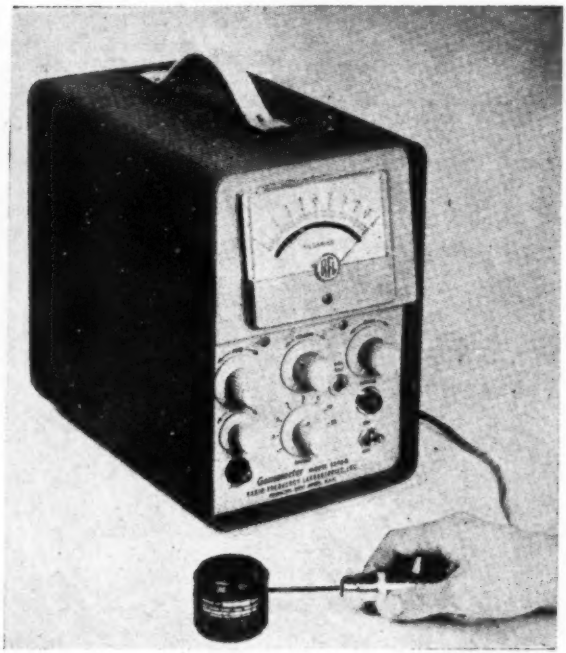

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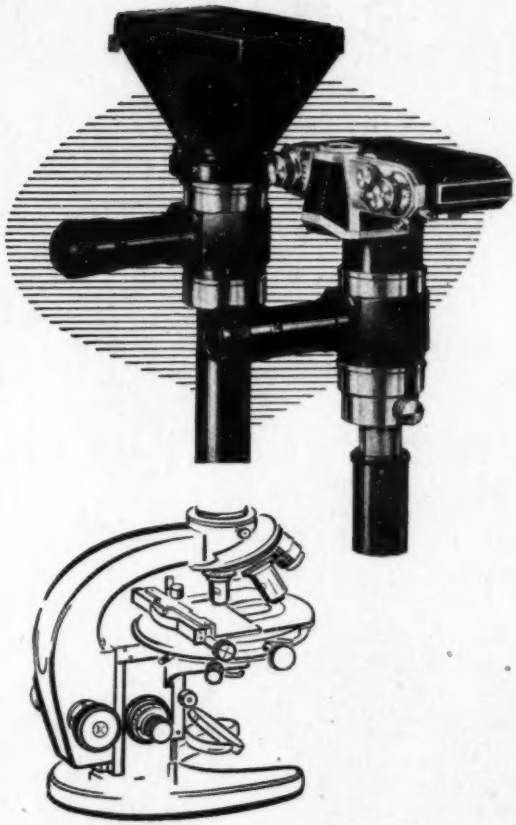

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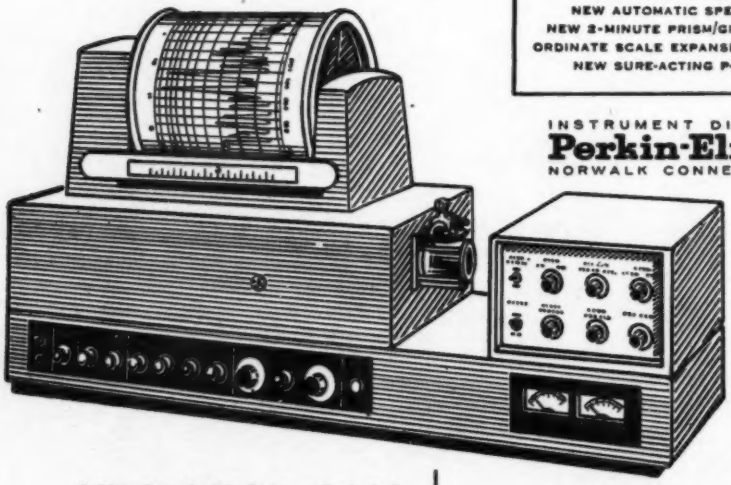

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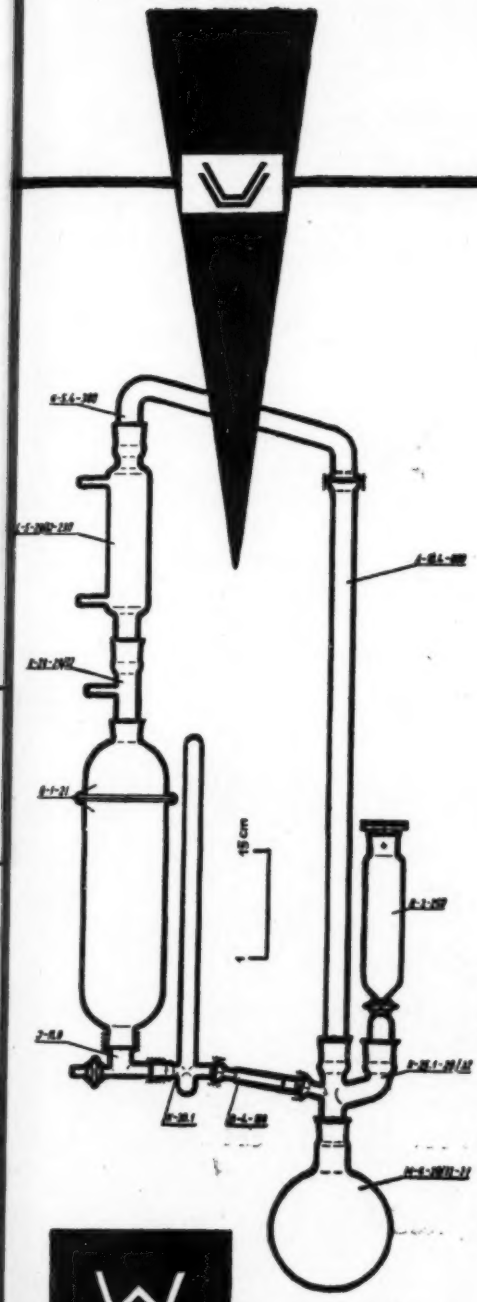

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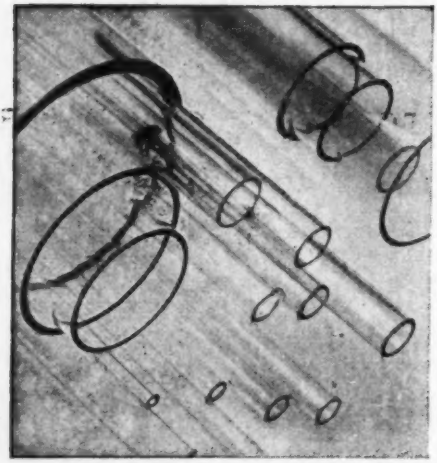

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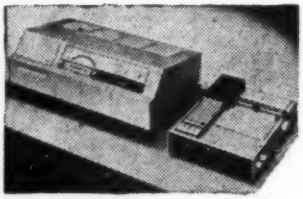

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TREATISE ON

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BLOOD GROUPING AND HUMAN TRISOMY

J. B. S. HALDANE

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LEJEUNE, Gautier and Turpin (1959) have shown that the human abnormality rather unfortunately termed mongoloid imbecility is usually due to trisomy, that is to say the presence of three, instead of two, of one of the 22 kinds of autosome. Penrose, Ellis and Delhanty (1960) have shown that it is sometimes due to partial trisomy resulting from translocation in an earlier generation. At least two other types of abnormality due to trisomy of other chromosomes have been described. These abnormalities no doubt occur in India, though they may be rarer than in Western Europe and North America, because mongolism, at least, is mainly found in the children of mothers over 40 years old, and such births are relatively rare in India.

Consider a mother belonging to group AB who bears a trisomic mongoloid infant. It probably receives two chromosomes from its mother. Let us consider what is expected if these chromosomes include the ABO locus. In the present state of our ignorance we cannot deny that they may sometimes be two A's or two B's. However, on almost any hypothesis they should sometimes be an A and a B. Thus if the ABO locus is on the chromosome of which a mongoloid possesses three, some mongoloid children of AB mothers and O fathers should belong to group AB.

Two other types of marriage could give evidence of the same kind. These are :—

$$A_1B \times A_2 \quad , \quad \text{and} \quad A_2B \times A_1 \quad ,$$
$$\qquad | \qquad\qquad\qquad\qquad\quad |$$
$$\qquad A_1B \qquad\qquad\qquad\qquad\quad A_2B$$

provided that in the last case the A_1 parent can be shown, either from examination of other children, or of the parents of the A_1 parent, to be A_1O and not A_1A_2.

In other cases the evidence from a single trisomic could not be decisive, but from a group of trisomics it could be so. For example, from $AB \times B$ we expect a little over ¼ AB offspring. If this was significantly exceeded, we should have evidence for the location of the ABO locus. In fact I only know of one mother of a mongoloid who belonged to group AB. Her case is recorded by Lang-Brown, Lawler, and Penrose (1953). She was A_1B, married an A_1 man, and had two mongoloid children of groups A_1B and B. It is thus certain that she produced one gamete not carrying both A and B, and she may have produced two. The argument is not essentially different in mongoloidism and other abnormalities due to partial trisomy following translocation, except that the marker locus must not be at the opposite end of the chromosome from the section whose trisomy is responsible for the abnormality.

The frequency of group AB in Britain is very low, about 3%. In India it probably averages about 8%, and many samples contain over 10%. No such high frequencies are found in Europe or North America, though they are equalled in Japan. Thus there is good reason for a search in India on the lines indicated. With suitable antisera the Rh and MNS loci could be studied in the same way; but such sera are rare in India, and the genotype frequencies at these loci give India no advantage over Europe.

I therefore appeal to Indian physicians and geneticists to investigate the blood groups of mongoloid and other trisomic human beings and of their parents, brothers and sisters. A fuller account of the theory will be published elsewhere. It is of course likely that the conclusions will be negative. But a proof that the ABO locus was not on the chromosome responsible for mongoloidism would be a contribution to human biology.

1. Lang-Brown, H., Lawler, S. D. and Penrose, L. S., *Ann. Eugen.*, 1953, **17**, 307-36.
2. Lejeune, J., Gautier, M. and Turpin, R., *C.R. Acad. Sci.*, 1959, **248**, 1721.
3. Penrose, L. S., Ellis, J. R. and Delhanty, J. D. A., *Lancet II*, 1960, 409.

CHROMOSOME ABERRATIONS AND MUTATIONS IN NATURE

(Miss) SUSAN THOMAS

Botany Department, Kerala University, Trivandrum

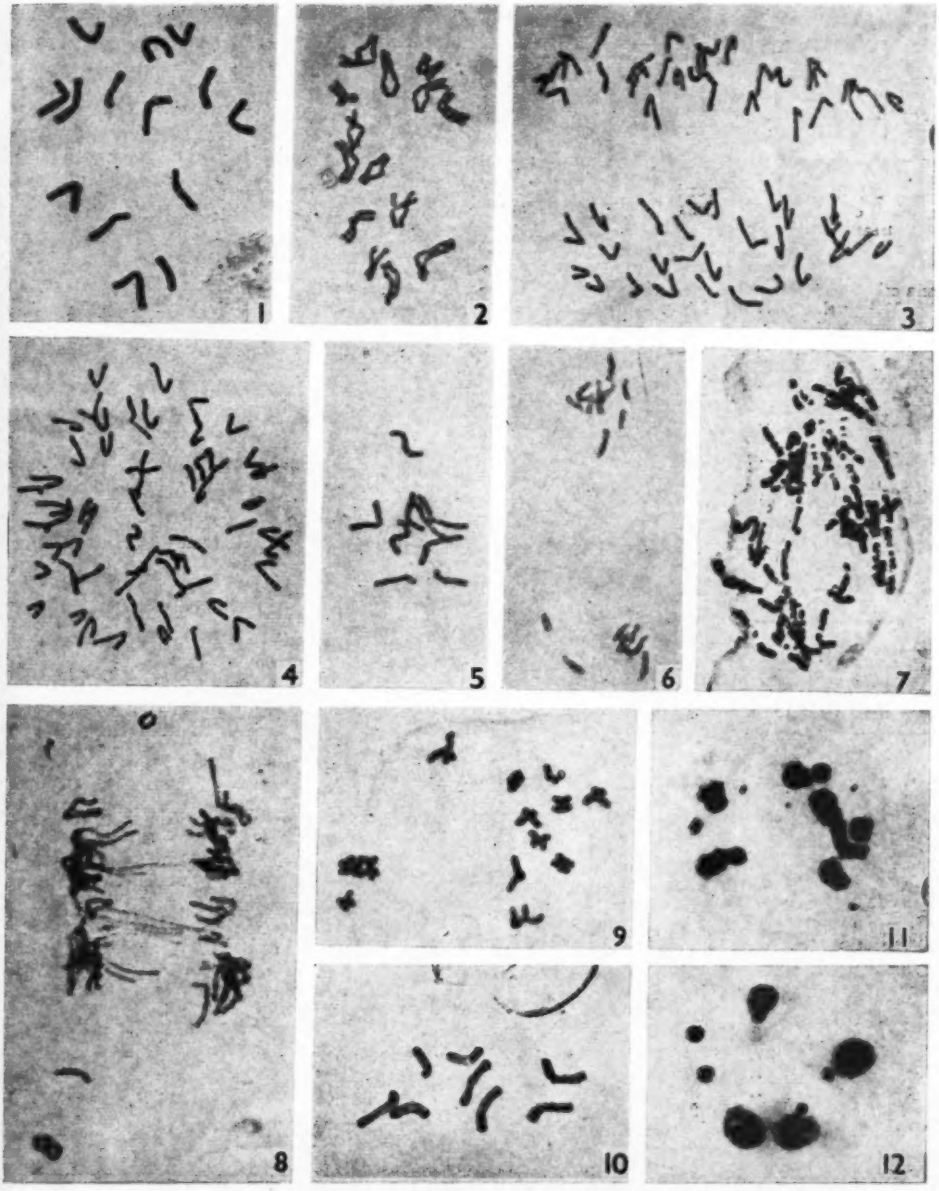
SPONTANEOUS occurrence of gene mutations and structural changes as well as numerical variation of chromosomes have been observed in nature. But the exact factors responsible for these changes have not been fully understood. In certain investigations on artificial induction of mutations conducted during the last three years it has been found that decaying organic substances normally used in agricultural practice, like compost and oil-cakes, have a marked effect on the structure and behaviour of chromosomes when applied in certain high concentrations.

In the course of their studies on mutation, Swaminathan and Natarajan[4] found that immersion of seeds in vegetable oils can cause breakage in chromosomes. The cytological and genetical effects of certain vegetable oils have been more fully reported on recently by them.[5] They have suggested that the unsaturated fatty acid components constitute the probable mutagenic fraction of the vegetable oil. Studies on the effect of oils carried out in this laboratory have not only confirmed their cytological observations, but have also shown that Bassia oil (from seeds of *Bassia latifolia* Roxb., family Sapotaceæ) is capable of inducing these changes very effectively in plants (unpublished). It has also been observed that oil-cakes are capable of inducing similar changes. Oil-cakes from which all traces of oil have been removed by Soxhelt method, and garden compost made from leaves and animal refuse have been found to produce the same effect. The fact that deoiled cakes and compost when mixed with sand in certain high concentrations produce these changes goes to show that there are other factors operative in bringing about these changes besides the constituents of the oil.

Experiments showed that very high concentrations of Bassia oil-cake (1 oil-cake : 5 sand) inhibited growth of the plant. Similar results were obtained with groundnut-cake, castor-cake and gingelly oil-cake, though the concentrations needed for effecting various types of chromosomal changes varied with the oil-cake used. Such inhibition in growth was not observed in the case of compost even when used without mixing with sand. The cytological effects induced by oil-cakes and compost have been studied in detail in *Chlorophytum heyneanum*, *Allium cepa*, *Trigonella fœnum græcum* and *Typhonium flagelliforme*. The plants were allowed to grow in pots containing varying concentrations of any one oil-cake or compost mixed with sand. An equal number of plants grown in pure sand or ordinary soil were kept as controls. The effect of vegetable cake and compost on the process of cell division appears to be almost similar in all these cases.

Cell division was normal in the root-tips of control plants, and in the case of *Chlorophytum heyneanum* 14 chromosomes were observed (Fig. 1). In the treated plants the chromosomes in many cells do not form a metaphase plate but are scattered throughout the cells. They split and often lie parallel to one another as in materials treated with C-mitotic agents (Fig. 2). But unlike in typical C-mitosis where the centromere division is delayed,[2] in this case the centromeres divide at about the same time or slightly earlier as indicated by the diverging of the daughter chromosomes from each other at this region only. It may be pointed out that according to Schrader[3] a spindle consists of two elements, an external spindle which arises by the activity of the centrosome or other polarising factors and an internal one formed in close connection with the centromere. The action of colchicine and other C-mitotic agents has been regarded as inactivating both the external and internal spindles (Levan,[2] Barber and Callan[1]). It seems that an inactivated external spindle alone produces the type of chromosome divisions as observed in Fig. 2. The formation of a restitution nucleus after such doubling gives rise to tetraploid nuclei (Fig. 3). Frequently this process is repeated and giant polyploid cells are formed (Fig. 4). The occurrence of multipolar and partially active spindles and somatic reduction (Fig. 5) may be responsible for the production of numerous aneuploid cells in the treated plants (Fig. 6). Considerable erosion of chromatin and fragmentation of chromosomes have also been observed in many cells (Fig. 7). Breakage of chromosomes followed by fusion usually results in the formation of ring chromosomes, chromatid bridges and acentric fragments at anaphase (Fig. 8).

The frequency of aberrations induced by Bassia cake in root-tip cells of onion and their



FIGS. 1–12. (× 700). Fig. 1. Somatic metaphase in the control plant of *Chlorophytum heyneanum* ($2x = 14$) Figs. 2–5 and 9–12 from *C. heyneanum* grown in compost unmixed with sand. Fig. 2. Chromosome doubling in root-tip cell showing early splitting of the centromere region. Fig. 3. Anaphase in root-tip cell showing doubled number of chromosomes ($4x = 28$). Fig. 4. A polyploid cell ($8x = 56$). Fig. 5. Metaphase in root tip cell showing 9 chromosomes instead of 14. Fig. 6. Somatic segregation in root-rip cell of *Typhonium flagelliforme* grown in compost unmixed with sand. Figs. 7 and 8 from *Allium cepa* grown in Bassia cake and sand (1 : 15). Fig 7. Root-tip cell showing fragmentation of chromosomes and erosion of chromatin. Fig. 8. Anaphase in root-tip cell showing chromatid bridges, ring chromosomes and acentric fragments. Fig. 9. Metaphase II in a PMC showing the unreduced number of chromosomes. Fig. 10. Pollen mitosis showing 8 chromosomes instead of the normal 7. Fig. 11. Diakinesis in a PMC showing fragments. Fig. 12. Tetrad stage in PMC showing four micronuclei.

relative frequency at various concentrations of the substance in the soil are recorded in Table I.

TABLE I

Frequency of cells showing chromosome changes at metaphase in roots of onion treated with varying concentrations of Bassia cake in sand

Nature of treatment	Total cells analysed	Number of normal cells	Number showing fragments	Number showing 'C-metaphase'	Number showing polyploidy	Number showing somatic segregation	Number of aneuploid cells	Percentage of cells showing aberrations
Bassia cake and sand (1 : 10 by weight) ..	154	106	16	20	4	7	1	31·2
(1 : 15" ") ..	264	198	20	22	4	8	12	25·0
(1 : 20" ") ..	148	116	18	5	1	6	2	21·6
(1 : 25" ") ..	242	190	16	14	6	6	10	21·5
(1 : 30" ") ..	127	111	8	2	..	4	2	12·6
(1 : 35" ") ..	248	236	5	3	..	2	2	4·8

It may be noted that the frequency of aberrations tends to increase approximately in direct proportion to the increase in the concentration of oil-cake in soil. In concentrations above 1 : 10 (by weight) mitosis is totally inhibited and no roots are produced. The effect of duration of treatment on the frequency of aberrations induced in *Chlorophytum heyneanum* grown in compost unmixed with sand is shown in Table II.

During meiosis, non-disjunction at anaphase I followed by the formation of a single interphase nucleus leads to the formation of cells with unreduced number of chromosomes at metaphase II (Fig. 9). Irregular distribution of chromosomes at anaphase I and II results in pollen with varying chromosome numbers (Fig. 10). Fragmentation of chromosomes (Fig. 11), inversion leading to the formation of chromatid bridges and fragments at anaphase, translocation, cytomixis, formation of dyads at the tetrad stage, clumping of chromosomes, etc.

TABLE II

Frequency of cells showing chromosome changes at metaphase in root-tip cells of Chlorophytum heyneanum *grown in compost unmixed with sand for different periods*

Duration of treatment	Total cells analysed	Number of normal cells	Number showing poly-ploidy	Number showing 'C-metaphase'	Number showing somatic segregation	Number showing fragments	Number of aneuploid cells	Percentage of cells showing aberrations
1 Month ..	104	55	32	8	1	3	5	47·1
2 Months ..	148	105	17	9	1	5	11	29·1
3 " ..	131	98	18	3	4	2	6	25·2
4 " ..	138	110	8	6	6	4	4	20·3
5 " ..	250	215	10	8	6	5	6	14·0
6 " ..	264	230	14	6	4	4	6	12·9
7 " ..	218	200	2	..	8	2	6	8·3

It can be seen that there is a gradual decrease in the percentage of aberrations observed as the period of treatment increases, this relation being found in the pollen mother cells also. This decrease can probably be attributed to the lowering of the nitrogen content of the compost, or the decrease in the concentration of any other substance causing these aberrations.

were observed in several cells. The presence of one or more micronuclei is a frequent feature in these plants (Fig. 12). All these abnormalities result in the production of an appreciable proportion of sterile pollen.

In another investigation using nitrogenous fertilizers like ammonium sulphate and urea, it has been found that solutions of these sub-

tances with nitrogen content varying from 0·15 o 0·02% produced almost identical results as egards chromosomal aberrations. It seems pos- ible therefore that in oil-cakes and compost lso the active agent in producing aberrations ay be the nitrogen present in these substances. n the absence of adequate amounts of other ssential elements like phosphorus and potassium, igh levels of nitrogen exert a toxic effect on rowth. This is borne out by the fact that lants grow well in compost even when it is ot mixed with sand, while growth is inhibited hen they are planted in a mixture of sand nd oil-cakes or nitrogenous fertilizers contain- ng the same level of nitrogen as in pure compost f the type used in the present study. The xtent to which other nutrients interfere with itrogen in affecting chromosomal aberrations re being investigated.

The present investigation has clearly shown hat decaying organic matter when present in oil in high concentrations can induce chromo- omal mutations of different magnitudes. While all chromosomal changes need not lead to viable mutations, the evidence from various studies and observations in this laboratory also show that some of them at least pass on to the next generation through vegetative as well as sexual reproduction. This indicates a partial answer to the wide occurrence of mutations in nature.

This work was carried out in the Botany Department of the University College, Kerala University. My thanks are due to Prof. A. Abraham for suggesting this problem and for guidance. I am also indebted to the Ministry of Education, Government of India, for the award of a Senior Research Scholarship and to the University of Kerala for research facilities.

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ECHO-I—THE US BALLOON SATELLITE

THE United States National Aeronautics and Space Administration (NASA), launched successfully on August 12, 1960, the largest balloon satellite *Echo-I*, in an experiment designed to test the feasibility of global communications by satellite reflections.

Echo is a 100-ft. sphere of aluminized plastic mylar, 0·0005" thick, and weighs about 125 lb. It was rocketed aloft deflated and packed in a 24½" canister in the nose cone of a Thor-Delta rocket. Upon ejection from the launcher, the two hemispheres of the canister separated and the plastic sphere was released free. Crystals of a subliming solid that had previously been injected into the sphere inflated the balloon; the sublimation process was to continue for a month or so to compensate for micrometeorite punctures.

The *Echo* was programmed to orbit 1000 miles up at 16000 miles per hour. Initially the orbit is inclined at 47° to the equator, and the period is 118·2 minutes. The orbit is nearly circular with a perigee distance of 1530 km. and an apogee distance of 1690 km.

Communications *via* the satellite were established during *Echo's* second revolution round the earth. The linking stations are Bell Telephone Laboratory's Station at Holmdel, N. J., and the Radio Astronomy Station at Goldstone, Calif. A special horn-reflector antenna recently completed at Holmdel is the eastern terminus of the satellite link. Goldstone is using its 85-ft. dish at the western terminus. Transmission frequency is 960 Mc westbound, about 2·39 Gc eastbound. F-m is used with a deviation of ± 150 Kc. at the highest modulation frequency of 3 Kc. *Echo* thus serves as a first step towards a worldwide communications system which would be independent of ionospheric disturbances. According to NASA report the communications satellite *Echo* is expected to remain in orbit for about a year.

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STUDIES IN PTERIDACEAE—III

Morphology of the Spores, Prothalli and Juvenile Sporophytes of *Doryopteris* J.Sm

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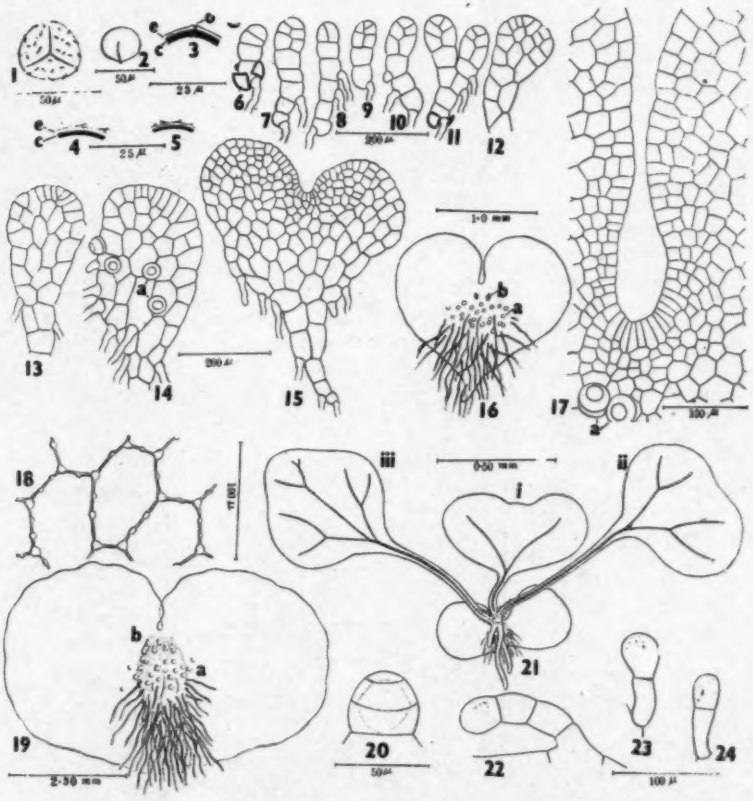
DORYOPTERIS is a large genus of terrestrial Gymnogrammoid ferns with about 35 species, the large majority of which are American, the only Indian representatives being *D. concolor* (Langsd. *et* Fisch) Kuhn and *D. pedata* (L.) Fee. It is regarded by most pteridologists as a genus of Cheilanthoid affinity (Ching, 1940[1]; Copeland, 1947[2]; Holttum, 1954[3]). In common with the other genera of the Gymnogrammoid ferns, the morphology of the gametophytes of *Doryopteris* is nearly unknown. The present communication is based on observations on *D. concolor* and *D. pedata*, made during the course of a comparative morphological study of the Indian Gymnogrammoideæ. Spores of *D. concolor* were collected from Kodaikanal Hills (South India) and those of *D. pedata* from plants cultivated in the fernery of the National Botanic Gardens, Lucknow. Morphology of the spores is based on acetolysed preparations mounted in Gylcerine jelly. Gametophyte morphology is based on cultures raised in the laboratory on Knop's Agar medium and on sterilised beds of deteriorated moss (for details of method see Nayar, 1960[5]). The cultures were maintained at a temperature of 23-28° C.

The spores *Doryopteris* are trilete (tetrahedral), tending to be globose and with a triangular to nearly circular amb (Figs. 1-2). The læsura is faintly crassimarginate (Fig. 3) and extends almost to the equator of the spore. The exine is about 2-3 μ in thickness in *D. pedata* (Fig. 5) while it is generally 3-4 μ or slightly more thick in *D. concolor* (Fig. 4). The surface of the exine bears sparsely distributed, thin, flap-like, irregular thickenings extending up to 2 μ from the surface. (The thickenings are not easily noticed on unacetolysed spores.) On an average the spores measure $30 \times 33\ \mu$ in *D. concolor* and $31 \times 35\ \mu$ in *D. pedata* (P × E). In both the species there is very little variation in the size of the spores.

The spores germinate within a fortnight in culture. The exine ruptures at the læsura, the spore coat often splitting into three valves. The rhizoid emerges first and then the germ papilla, which soon develops chloroplasts. The germ papilla elongates and develops into a 4-6-celled germ filament, in which the cells are usually broader than long (Fig. 6). Flattening of th germ filament is initiated by longitudina divisions of the anterior cells (Fig. 7). Th terminal cell itself divides longitudinally by a oblique wall (Fig. 8), soon followed by anothe wall at an angle to it cutting off an apical wedge-shaped meristematic cell (Figs. 9-10) Rarely an apical wedge-shaped cell may b formed earlier to the longitudinal divisions i the penultimate cells. Marginal rhizoids ar formed profusely on the basal half of the pro thallus. The rhizoids are hyaline and posse slightly dilated bases. Some of the germ filaments may branch towards the apex, eac branch developing into a separate prothallu (Fig. 11). The prothallus soon become spatulate in the usual way, by the activity o the apical cell (Figs. 12-14). Due to vigorou growth of the anterior end of the thallus th apex gradually becomes notched, with th apical cell placed at the bottom of the notch Soon the thallus becomes cordate (Figs. 15-16 and the meristematic cell is replace by a multicellular meristem compose of 6-10 narrow columnar cells (Fig. 17). Pro thalli reach maturity within 4 to 5 months o growth. The mature prothallus (Fig. 19) i naked, cordate, broader than long and with a thin central midrib bearing the nearly semicir cular wings on either side. The apex is deepl notched, with the sides of the notch often over lapping slightly. The wing cells possess pro minent collenchymatous thickenings of th corners and thick wart-like thickenings distri buted along the lateral walls (Figs. 18). Thes thickenings appear irregularly circular an silvery in fresh material. The midrib is usuall composed of 5-6 layers of narrow cells whic are slightly elongated parallel to the long ax of the prothallus.

Antheridia are produced by prothalli from th spatulate stage onwards. In the early stage they are both marginal and superficial on th ventral surface. Antheridia (Fig. 20) ar subglobular, small and similar to the antherid of *Hemionites* (Nayar, 1956[4]). The opercula cell opens out like a lid to release the sperm Archegonia are formed only after midrib forma tion, and are similar in structure and develop ment to that of *Hemionites* (Nayar, 1956[4]).

Fertilisation is quite frequent under cultural conditions and young sporophytes are formed by vigorously growing thalli nearly 6 months old. The first juvenile leaf usually is broadly spatulate with a flatly rounded, or sometimes dichotomising twice (Fig. 21-ii). Generally a midrib is established by the third leaf and it originates as a separate branch from the base of one of the branches of the first dichotomy (Fig. 21-iii). The apex of the lamina becomes



FIGS. 1–24

Fig. 1. Spore of *D. pedata* (proximal view). Fig. 2. Same (lateral view). Fig. 3. Optical section of exine at the region of the læsura. Fig. 4. Portion of exine of spore of *D. concolor* showing stratification. Fig. 5. Same, of *D. pedata*. Fig. 6 Germ filament of *D. pedata*. Fig. 7. Same, showing initiation of flattening of apex. Fig. 8. Germ filament of *D. pedata*, showing oblique division of the terminal cell. Fig. 9. Germ filament of *D. concolor*, showing establishment of apical meristematic cell. Fig. 10. Same, in *D. pedata*. Fig. 11. Branched germ filament of *D. pedata*. Figs. 12–14. Stages in the development of spatulate apex in young prothalli of *D. pedata*. Fig 15. Young thallus of *D. concolor*, showing formation of a multicellular meristem. Fig. 16. Young cordate prothallus of *D. pedata*. Fig. 17. Apex of the same, showing details. Fig. 18. Wing cells of mature prothallus of *D. pedata*. Fig. 19. Mature prothallus of *D. pedata* (ventral view). Fig. 20. Full-grown antheridium. Fig. 21. Young sporophyte of *D. concolor*, still attached to the prothallus (*i*, *ii* & *iii* represent the 1st, 2nd and 3rd juvenile leaves). Figs. 22–23. Hairs on the stipe of juvenile leaf of *D. pedata*. Fig. 24. Hair on the lamina of the same. (*a*—antheridium; *b*—archegonium; *c*—endoexine; *e*—ectoexine; *s*—læsura).

slightly notched, apex (Fig. 21-i). The single vein which enters the lamina forks into two at the base, the branches diverging and ending much below the margin. The next leaf, or in some cases the first leaf itself, may have the veins pronounced and the midrib in the succeeding leaves bears branches alternating on either side. The stipes of all the juvenile leaves are deep-brown in colour. The first juvenile leaf has a naked lamina. Small, club-shaped hairs with

a one- or two-celled stalk and a slightly swollen apical cell with brownish, dense contents occur sparsely towards the base of the stipe. The hairs at the base of the stipe of the second leaf usually develops into small paleæ. The paleæ are formed by the elongation of hairs similar to those on the first leaf, followed by longitudinal divisions of the cells of the basal half resulting in flattening. The terminal cell of the palea is globular and with dense contents. Multicellular, uniseriate hairs occur along the stipe and small club-shaped hairs occur very sparsely spread over the lamina of the second and third leaves.

Morphology of the spores and gametophytes of the other genera of Gymnogrammoideæ is being studied and a comparison between t various genera will be presented later.

The author is deeply indebted to Pr K. N. Kaul, Director, for encouragements.

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METEOROLOGICAL ROCKET–FIRING NETWORK

FOR over twenty years weather balloon technique has been playing an essential part in weather forecasting in all the countries of the world. Radio-sonde balloons launched twice or more daily from a network of stations throughout the world, provide data on wind, pressure, temperature and humidity in the high atmosphere. However, the meteorological probing of the upper atmosphere by the balloon technique is limited to an altitude of about 100,000 ft. or 20 miles. The use of rockets as meteorological tools has opened new heights in the study of the atmosphere, and a network of rocket-firing stations to gather meteorological data of the upper atmosphere to an altitude of more than 40 miles is envisaged in the International Rocket Weeks Programme sponsored by the Committee of Space Research (COSPAR).

Successful experiments were initiated in this programme by a meteorological working group of the Space Science Board of the National Academy of Sciences, U.S.A. From January 18 to February 19, 1960, low cost *Loki* and *Arcas* rockets carrying instruments to obtain meteorological data in the upper atmosphere were simultaneously fired daily from Wallops Island, Va., and Point Mugu, Cal. Similar monthly firing periods took place in the spring and summer, and these will be followed by one in the fall of the year. In future daily launchings, which will occur in each of the four seasons of the year, other stations also will take part, thus forming a meteorological rocket-firing network. The simultaneous firings from widely separated points afford a means of gathering precise and extensive meteorological data to large heights which no other existing method can provide.

The rockets employed in the network rea altitudes of over 40 miles and primarily gath data on winds, which are obtained by trackin by means of radars the paths of parachutes clumps of falling "chaff". It is expected th improvements in the rocket system will le to routine observations of temperatures a pressures as well.

It has been learned that winds in the regi of the atmosphere which is being explored m exceed 250 miles per hour, and that remarkabl changes in this wind sometimes occur. Exact how these changes affect the weather low down in the atmosphere is not yet known, b meteorologists will be able to study this proble with the aid of the new data which will becom available.

The *Loki* is a solid-propellent rocket and i little more than a yard long when separate from its booster. It carries a payload metallic confetti, or chaff, that is ejected b explosion at the desired altitude. As the cha drifts through space, it is tracked by radar t measure winds.

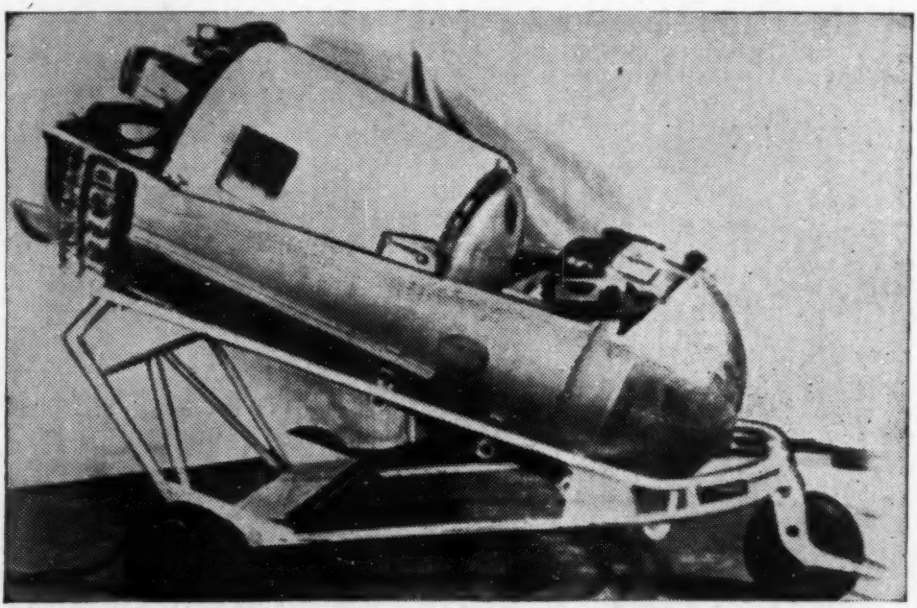
The *Arcas* is a solid-propellent rocket 8 f long, weighs 77 pounds, and carries an instru mentation package of 12 pounds. The no cone of the *Arcas* separates from the main bod of the rocket at altitude and is tracked by rad as it drifts earthward on a parachute. A tel metry package in the nose cone sends ba temperature information. Rawin (radio wind ground equipment at each of the stations pro vides recording of data and tracking throug direction-finding equipment.

—*Bull. Amer. Met. So*

RUSSIAN SPACE-SHIP—II

ON August 19, 1960, Russia launched the second space-ship into orbit round the earth. It weighed 4,600 kg. as against the weight of 4,540 kg. of the first space-ship launched on May 15, 1960. The space-ship was placed in an orbit close to circular, with an apogee of 339 km. and a perigee of 306 km. The initial period of revolution was 90·7 minutes, the inclination of the orbit to the equator's plane—64 degrees 57 minutes. The ship carried on board two dogs, Strelka and Belka, and other animals—40 mice, 2 rats, insects—as well as plants, grains of cereal crops and micro-organisms, with a view to study the effects of radiation and space flight conditions.

Thirteen white laboratory mice and 15 black mice and 2 white rats made the flight in the cabin of the space-ship. The catapulted capsule along with Belka and Strelka contained 6 white and 6 black mice, insects—Drosophiles in 15 flasks—, the plant Tradescantia in 2 flasks, the plant Chlorella in 8 ampules in a liquid nutritive medium in the form of suspensions and 4 ampules on slanted agar, fungi—Actinomyces in 14 ampules; seeds of maize and wheat of different varieties, peas, onions and Nigella. Moreover, the capsule contained small sections



The pressurised capsule with animals inside the container ejected from the Soviet Space-ship—II.

After one day's flight and during its 18th revolution, when the ship had covered more than 700,000 km. around the earth, the cabin and the capsule containing the animals and test materials were successfully brought down by command signals transmitted from the earth. The space ship's control system and braking device operated with great accuracy and ensured the ship's descent to within 10 km. of the calculated spot. The flight of the second space-ship is particularly significant not only from the view-point of the medico-biological experiments thus staged, but also as regards, technology and engineering.

of human and rabbit skin in 2 ampules, cancer cells in 6 ampules; microbes: enteric bacillus "K-12" in 11 ampules, enteric bacillus "V" in 6 ampules, enteric bacillus of the "aerogenes type" in 4 ampules, butyric fermentation bacillus in 2 ampules, Staphylococci in 2 ampules, Desoxynucleinic acid in 6 ampules, bacteriophag "T-2" in 3 ampules and bacteriophag "13-21" in 3 ampules.

The scientific equipment installed in the space-ship included instruments for investigating light

and heavy nuclei in the primary cosmic radiation, for studying the ultra-violet radiation of the Sun, for registering levels (doses) of cosmic radiation in the container with animals.

Blocks of thick nuclear photo-emulsions totalling about 60 kg. were installed in the spaceship. One of the photo emulsion blocks was fitted with a device for the development of the emulsions directly on board the ship. The scientific information was memorized and relayed to the earth at a special command. The memorized information was relayed after each revolution of the ship around the earth as well as before the landing.

DARWIN'S CENTENARY ESSAYS *

HERE is a volume of essays devoted to a re-examination, in the light of accumulated knowledge during the past 100 years, of the work of Charles Darwin. Six essays are presented, evidence that Darwin directed his attention to several fields in addition to Organic Evolution. The first essay by P. R. Bell summarizes the recent work on Phototropisms and concludes by raising more problems than it solves. Phototropism is not the simple phenomenon which it was believed to be. Darwin was attracted by the responses of plants to illumination. He was doubtless aware of the remarkable powers of plants to differences in illumination but he could not have imagined the stimulus his work was to give to succeeding generations of plant physiologists. What was a wonder to Darwin became, to the modern investigator of plant movements, a challenge which has not yet been fully met. For, the question as to how light energy affects the functioning of cells, has only just been asked and the whole lot of biochemical and biophysical problems involved in the processes of plant response are being examined in the light of newer disciplines and tools available to the investigator. That all control of form and development is to be ascribed to auxins and their interaction with auxin inhibitors is however becoming clear. Haldane's essay is a masterpiece of analysis of forces of Natural Selection. Darwin was unaware of the laws of inheritance and if there is one field of modern Biology which has had the profoundest influence on the understanding of organic evolution it is the laws of Genetics. The full consequences of Darwinism in the light of modern genetical work are still to be realized. But work like that of Kettlewell on industrial melanism has illustrated Natural selection at work.

Darwin's genius took him into unusual and interesting fields including that of animal communication. Many a recent student has derived his inspiration from his penetrating analysis of human and animal behaviour especially because he derived inspiration for his observations in Nature. Marler's essay summarizes the work done in the fields of Visual and auditory communication since Darwin. Of this, nothing is as spectacular as that on bird song and its evolution. Any discussion on communication must include the origin of human language, which was recognized by Darwin as nothing so unique as not to be explained on the basis of Organic Evolution and for which modern work has provided additional confirmation. H. L. K. Whitehouse discusses recent work on the fertilization in plants. Darwin had, from his earliest days, been struck by the remarkable contrivances which flowers of many plants displayed, and felt they were adaptations to achieve cross-fertilization. He was, therefore, among the first to focus attention on the problem of cross-fertilization as superior to self-fertilization and the diverse methods obtaining in nature to achieve it. Whitehouse goes on to integrate the Mendelian laws of inheritance into this picture of Darwin's ideas and experiments and to establish the need for experimental work to determine the evolution of cross-fertilizing mechanisms in plants.

The last essay by Wilkie is a historical assessment of the work of Darwin. It is often stated that Darwin's theory of Evolution was in no way the original and unique contribution it is made out to be, but that everything he said had been said by some one or the other who preceded him. Wilkie's brilliant analysis puts the work of Darwin in its proper perspective and determines the undeniable originality of his contribution.

The book is a masterly exposition of practically every concept of Darwin in the light of modern work and should be of immense usefulness to students of Darwinism. Were Darwin alive today, he would derive immense satisfaction from the fact that the ideas which he propounded have brought a stimulating response in many minds.

* *Darwin's Biological Work (Centenary Essays).* Edited by P. R. Bell, (Cambridge University Press), 1959. Pp. xiii + 343. Price 40 *sh.* net.

LETTERS TO THE EDITOR

TOTAL CROSS-SECTIONS FOR THE NUCLEAR SCATTERING OF 765 MeV NUCLEONS

USING the optical model of the nucleus, proposed by Fernbach, Serber and Taylor,[1] Gatha, Shah and Patel[2] have analysed the nuclear scattering of 340 MeV nucleons and obtained a characteristic nuclear density distribution for light elements.

In the present investigation, we have calculated σ_t, the total cross-sections for the nuclear scattering of 765 MeV nucleons using the formula derived by Gatha and Shah.[3] We have taken $\overline{k}_1 = 10$ mbn. from Jastrow's hard core nucleon model which is practially the same as at 400 MeV. The absorption parameter $\overline{K}$ is calculated from the experimental values of $\sigma_{np} = 34{\cdot}4$ mbn.[4] and $\sigma_{nn} = \sigma_{pp} = 45{\cdot}0$ mbn.,[5,6] which in the present investigation comes out to be 39·7 mbn. The calculated values for the total cross-sections using these parameters are given in Table I, together with the experimental values of σ_t at this energy.[4]

TABLE I

Total cross-section in millibarns

Element		Theoretical	Experimental
Li	..	212·8	221·2 ± 4·7
C	..	346·7	342·1 ± 3·7
O	..	444·6	460·7 ± 6·0
Al	..	689·6	660·2 ± 7·3

The above comparison shows that the characteristic nuclear density distribution for light elements and the parameters of the complex refractive index selected in the present investigation gives reasonable values for the total cross-sections for this scattering process.

Bhavan's College, Andheri, Bombay-58, *September* 3, 1960.

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SCATTERING OF HIGH ENERGY ELECTRONS BY CARBON AND OXYGEN

A LARGE amount of experimental data on the elastic scattering of high energy electrons by Carbon and Oxygen is now available. In most cases,[1] the relative values of the differential scattering cross-section have been reported. However, only in very few cases,[2] the absolute values have been given.

Assuming the validity of the Born approximation, Gatha *et al.*[3] have expressed the formfactor $g(\bar{s})$ as,

$$\bar{s}\, g(\bar{s}) = \int_0^\infty \bar{r}\, \rho(\bar{r}) \sin(\bar{s}\,\bar{r})\, d\bar{r} \quad .. \quad .. \quad (1)$$

where $\rho(\bar{r})$ represents the density of protons in the nucleus and

$$\bar{r} = r\, A^{-1/3}; \quad \bar{s} = s\, A^{1/3} \text{ and } s = 2k \sin(\theta/2).$$

It follows from equation (1) that if an identical characteristic density distribution $\rho(\bar{r})$ holds good for both Carbon and Oxygen, the graph $g(\bar{s})$ against $\bar{s}$ will be the same for both the elements, for all electron energies.

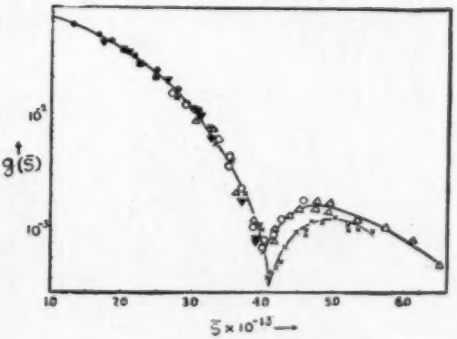

FIG. 1

● C 187 MeV		■ C 150 MeV	
× C 429 MeV		▼ O 240 MeV	
○ O 360 MeV		△ O 420 MeV	

Figure 1 shows the variation of $g(\bar{s})$ with $\bar{s}$ for Carbon and Oxygen for various values of electron energies. In this connection it may be pointed out that no multiplying factor was found necessary in fitting the relative curves into absolute curves. The curves for Carbon and Oxygen appear to coincide except in the

region of large $\bar{s}$. The small divergence in $g(\bar{s})$ curves for large $\bar{s}$ may either be due to the fact that the Born approximation deviates from the exact analysis especially for large $\bar{s}$, or may in part be due to the fact that the idea of characteristic density distribution assumed for nucleons may not be strictly applicable in the case of protons. A forward analysis which is under investigation is expected to throw some light on this.

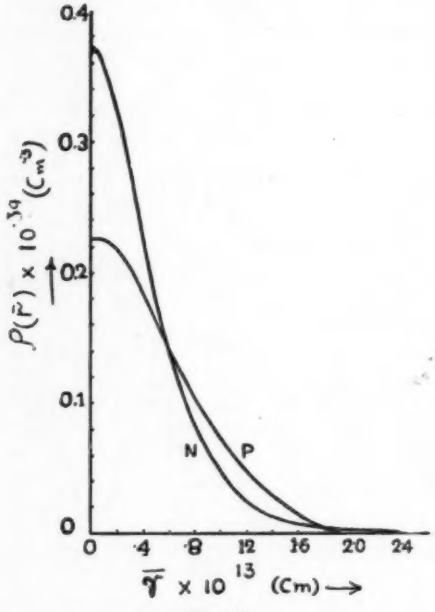

FIG. 2

Curve P represents the proton density distribution for Carbon obtained by present analysis while curve N is the characteristic nucleon density distribution obtained by Shah and Gatha.

Figure 2 shows the variation of $\rho(\bar{r})$ of Carbon as a function of $\bar{r}$ obtained by Fourier inversion of equation (1). Following a similar technique, Gatha *et al.*[4] have analysed the experimental data on the nuclear scattering of protons and obtained the characteristic nucleon density distribution which is also plotted in the same figure for comparison. The actual proton density in terms of $\bar{r}$ can be obtained by multiplying $\rho(\bar{r})$ of the curve P by the normalisation constant Z/A which is ½ for Carbon. The nucleon density given by curve N is already normalised. Since the nucleon density is equal to the sum of the proton density and the neutron density, the neutron density can be found from the curves N and P. The proton density is equal to the neutron density at the points of intersection of the two curves. They are also the points where the densities cross each other. It can be easily seen from the curves that the neutron density exceeds the proton density in the innermost core and also near the periphery of the Carbon nucleus. However, the reverse is true midway between the core and the periphery. This inference is in agreement with the conclusions of other workers[5,6] regarding the densities near the periphery.

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X-RAY METHOD FOR DETERMINING GRAIN-SIZE IN ROCKS

IN recent years, the determination of grain-size in rocks has assumed importance as it has been found[1] that several physical properties of rocks like sound absorption and sound velocity are influenced by the grain-size. The usual method of determining the grain-size is to prepare a thin section of the rock (thickness about 0·03 mm.) and measure the diameter of about 200 grains taken at random, using a polarising microscope provided with a mechanical stage and a vernier. The average of these values is taken as the grain-size. The method, besides being tedious, has the following defects:

1. The measurement represents the size of only a section of the grains in a particular plane and not the over-all grain-size.

2. As the number of grains on which measurements are made cannot be very large, the average value obtained may not be a good approximation to the over-all average. Hence it is attempted, in this investigation, if an X-ray method is suitable for determining the grain-size in rocks.

Several X-ray methods have been used in the past to determine the grain-size in metals.[2] One method[3,4] is to count

the number of spots on a Debye-Sherrer ring in the transmission or back-reflection photograph obtained by irradiating the stationary specimen with characteristic X-radiation. Assuming that the grains are roughly cubic in shape, the mean length of the grain-edge 'G' is given by the expression

$$G = \sqrt[3]{\frac{Vpa\cos\theta}{2DY}}$$

where 'Y' is the number of spots on the Debye-Sherrer ring, 'V' the volume of the specimen irradiated, '*p*' the multiplicity factor of the X-ray reflection, '*a*' the diameter of the collimator, 'θ' the Bragg angle of the X-ray reflection and 'D' the specimen to film distance.

In this investigation, using the transmission method, the grain-sizes of a number of specimens of quartzite are determined and the values are compared with those obtained by the usual optical method. The specimen (thickness about 0·3 mm.) is irradiated by Cu K_α radiation from a Philips X-ray unit working at 30 KV and 15 mA., with a specimen to film distance of about 7 cm. The diameter of the collimator is selected to suit the specimen. In the case of a coarse-grained rock a 2 mm. collimator has been used to get enough number of spots on the Debye-Sherrer ring. For fine-grained specimens a 1 mm. collimator is used to avoid overcrowding and overlapping of the spots. The diffraction ring corresponding to (101) planes has been selected for counting the spots. In each case, the portion of the specimen irradiated by X-rays is marked on the specimen and the diameters of 200 grains in that portion are measured by the optical method after thinning down the specimen to about 0·03 mm. The results obtained in three typical cases are given in Table I. Figure 1 gives the X-ray photographs obtained for specimens 1 and 3.

TABLE I

Specimen number	Thickness of the specimen (X-ray method) (in cm.)	Diameter of the collimator (in cm.)	Number of spots on the Debye-Sherrer Ring	Grain-size by X-ray method in mm.	Grain-size by optical method in mm.	Number of grains involved in the X-ray method
1	0·033	0·203	460	0·073	0·070	2790
2	0·057	0·203	326	0·098	0·085	1979
3	0·045	0·100	322	0·045	0·043	3969

The results in Table I show that there is good agreement between the values obtained by the two methods. It may be mentioned that the value given by the X-ray method is a better approximation to the over-all average grain-size, as the number of grains involved is very large. In view of the promising results obtained, the method is now being extended to determine the grain-size in still coarser and finer grained rocks using suitable collimators and the grain-sizes of different minerals in multimineral rocks.

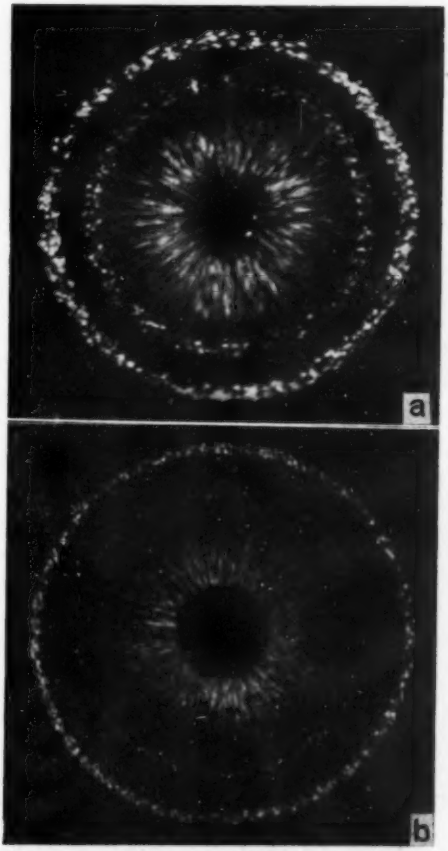

FIG. 1. Showing the Debye-Sherrer rings for Specimens 1 and 3. The inner ring is due to (100) reflection and the outer one is due to (101). (*a*) Coarse-grained specimen with 2 mm. collimator. (*b*) Fine grained specimen with 1 mm. collimator.

In conclusion, we wish to express our thanks to Dr. S. Balakrishna for many useful discussions.

Physics Department, Osmania University, Hyderabad-7, *September* 10, 1960.

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ON PURIFICATION OF FOLIC ACID

FOLIC acid, even B.P. quality, may often contain some impurities, most probably due to the photochemical changes, and as such it is sometimes found unsuitable for a standardisation work. Sakami and Knowels[1] (1959) have reported a chromatographic procedure for purifying folic acid freed from all free amines and other fluorescent matters. The chromatographic procedure has been found to be fairly time-consuming. As such fresh attempt has been made to work out a simpler technique for purifying folic acid with better recovery. This has been achieved by forming an insoluble complex salt of folic acid with cetrimide.

An aqueous solution of folic acid (B.P.), containing about 35 mg. per ml., was exposed to light until the folic acid content came down to about 30 mg. per ml., as assessed according to Hutchings *et al*.[2] To this solution was added *p*-aminobenzoic acid 1 mg. per ml. as an impurity. Bentonite used in the experiment was supplied by M.G. Corporation of Bombay.

The whole process of purification has been carried out in the dark at room temperature. Folic acid solution (5 ml.) was precipitated with 1% solution of cetrimide (29·5 ml.) and the harvested precipitate was washed twice with distilled water (10 ml. × 2). The precipitate was then suspended in 4% sodium citrate solution (8 ml.) and slowly with stirring ethanol (8 ml.) was poured in, when the complex salt dissolved completely. The solution was filtered through Whatman (No. 42) paper and acidified to pH 4·0 with acetic acid to precipitate the folic acid. The precipitate obtained was again dissolved in a mixture of 4% sodium citrate (5 ml.) and ethanol (5 ml.), pH being adjusted to about 7·0, and filtered as above. The filtrate was precipitated at pH 4·0 with acetic acid, and the precipitate was dissolved in distilled water (10 ml.) by adjusting pH to 7·0 with sodium hydroxide. The solution was subsequently admixed with bentonite (0·25 gm.), and filtered through Whatman (No. 42) paper. The pure folic acid was then precipitat at pH 4·0 with acetic acid, washed twice wi ethanol (5 ml. × 2) and twice with aceto (5 ml. × 2) and dried over calcium chlori under vacuum, the yield being about 125–130 m

The purified bright yellow folic acid w found to be absolutely freed from any fr amine (Bratton and Marshall)[3] as well as fr all fluorescent matters (Sakami and Knowels)

Authors wish to thank Dr.U. P. Basu, for h keen interest in this work.

Bengal Immunity, Res. Institute, Calcutta-16, *July* 6, 1960.

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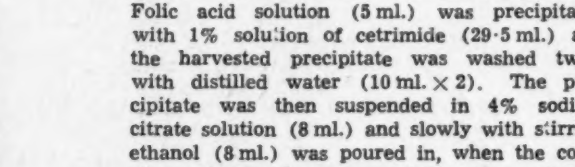
AMPEROMETRIC DETERMINATION OF ANTIMONY AND THIOCYANATE WITH HYPOBROMITE

OF the numerous methods available for th determination of antimony and thiocyanate, th volumetric procedures are found to be mo accurate and rapid. Generally, antimony i trivalent condition is determined with chlor amine T[1] and potassium bromate,[2] and thiocya nate by Volhard's method[3] using a standar solution of silver nitrate. Following the appli cation of sodium hypobromite as an oxidant i the alkaline medium,[4] and in amperometry its utility in the oxidation of selenite[6] at th rotating platignum micro-electrode was reporte earlier from these laboratories. The possibilit of an extended application of this procedure t several other oxidation reactions has bee investigated. Preliminary experimental result showed the oxidation to be complete in the ca of Sb^{+3} and thiocyanate at a pH of 7·0–8· More detailed study revealed that accurate an reproducible results are obtained at a pH o 8·2. Thus, Sb^{+3} in tartar emetic required on oxygen atom and thiocyanate four oxygen ato for the oxidation to be complete, and the pro cess may be represented by equations (1) an (2) respectively.



Stock solutions of sodium hypobromite (0·06 M approx.), sodium arsenite (0·1 N) and sodium bicarbonate (0·6 M approx.) were prepared, and a simple form of amperometric unit was used, as described by Kolthoff.[5] A rotating platignum micro-electrode and the S.C.E. served as the indicator and reference electrodes respectively. The titrations were carried out at + 0·3 V *vs.* S.C.E. Solutions of tartar emetic and potassium thiocyanate were obtained from pure samples (E. Merck) and standardised with chloramine T[1] and $AgNO_3$[3] respectively.

Aliquots of solutions of Sb^{+3} and $-CNS^-$ were taken in a 150 ml. pyrex beaker containing about 10 ml. of 0·6 M (approx.) sodium bicarbonate solution to maintain an overall pH of 8·2. The contents were diluted to 50 ml. and titrated with NaOBr, standardised earlier with sodium arsenite at the same pH in bicarbonate buffer. A set of observations are returned in Table I.

TABLE I

Determination of antimony and thiocyanate

Amount		%	Amount		%
Taken (mg.)	Found (mg.)	Error	Taken (mg.)	Found (mg.)	Error
Antimony			Thiocyanate		
9·786	9·819	+0·337	3·287	3·259	−0·852
8·155	8·162	+0·086	2·670	2·625	−0·189
6·524	6·533	+0·140	1·972	1·959	−0·660
4·893	4·891	−0·141	1·643	1·635	−0·487
4·077	4·086	+0·466	1·315	1·310	−0·380
3·262	3·291	+0·889	0·9861	0·9860	−0·001
2·443	2·448	+0·082	0·6574	0·6589	+0·228
1·631	1·626	−0·307	0·3287	0·3306	+0·578

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Chemical Laboratories, Banaras Hindu University, Banaras-5 (India), July 28, 1960.

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MODIFIED METHOD OF USING DIBORANE FOR SELECTIVE REDUCTIONS

BROWN and Subba Rao[1] have described that Diborane—gaseous or prepared *in situ*—could be used for the selective reduction of carboxylic acids to the corresponding alcohol in high yields. This method is specially advantageous when, in addition to the carboxylic group, the compound contains other easily reducible groups such as nitro, acid chloride and ester groups.

We had occasion to reduce several carboxylic acids containing other functional groups, such as dinitro-, hydroxy nitro-, polyhydroxy compounds. We found that the *in situ* method (generating diborane within the system by the addition of calculated amounts of BF_3 etherate to sodium borohydride in diglyme) failed to yield the desired reduction products. Gaseous diborane method also failed in hydroxy-, polyhydroxy- and hydroxynitro acids. In some cases, as with salycylic acid, reduction did not proceed at all while in others by-products were predominant.

We have, however, found that the diborane reduction of poly functional carboxylic acids in the benzene, naphthalene and anthracene ring systems is best carried out using gaseous diborane only in an ether solvent (ethyl ether, THF, dioxane, monoglyme, diglyme) after acetylating the free hydroxy groups, if any, present in the compound. Acetylation of the compound, in such cases, has also been found to increase their solubility in these ethers and avoids the precipitation of the complex that would normally occur with free hydroxy compounds.

The modified method simply consists of passing slight excess of diborane gas into the solution of the compound/acetylated compound in an ether solvent at room temperature, hydrolysing the reaction mixture at the end of one hour and working up the reaction products.

The following reductions have been carried out in 75-95% yield by the modified method :

2-Hydroxy-4-nitrobenzoic acid → 2-Hydroxy-4-nitrobenzyl alcohol ;

1-Chloro-3-nitro-2-benzoic acid → 1-Chloro-3-nitrobenzyl alcohol ;

3 : 5-Dinitrobenzoic acid → 3 : 5-Dinitrobenzyl alcohol ;

3 : 5-Dinitrophenyl acetic acid → 3 : 5-Dinitrophenylethyl alcohol ;

3 : 5-Dinitro salycylic acid → 3 : 5-Dinitro salicyl alcohol ;

2 : 4-Dihydroxy naphthoic acid → 2 : 4-Dihydroxy naphthyl alcohol ;
3-Hydroxy-4-nitronaphthoic acid → 3-Hydroxy-4-nitro naphthyl alcohol ;
3 : 5-Dinitro anthraquinone-2-carboxylic acid → 3 : 5-Dinitroanthraquinone-2-carbinol ;
1 : 8-Dihydroxy anthraquinone-2-carboxylic acid → 1 : 8-Dihydroxy anthraquinone-2-carbinol.[2]

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ANALYTICAL APPLICATIONS OF TETRAHYDROXY QUINONE AND ITS RELATIONSHIP WITH RHODIZONIC ACID

TETRAHYDROXY quinone is known to give coloured products with Ba^{++}, Pb^{++} and Sr^{++}[1,2]. In a previous communication[3] we have reported that it reacts with a large number of cations, *viz.*, Pb^{++}, Tl^{+}, Ag^{+}, Hg^{+}, Ba^{++}, Sr^{++}, Ca^{++}, Hg^{++}, Bi^{+++}, Cd^{++}, Zn^{++}, Sn^{++} and UO_2^{++}, the colour reactions being similar to those described for sodium rhodizonate.[4] Based on the above limited observations, we concluded that the analytical behaviour of these two reagents towards metal ions was the same. As a result of further investigations, described below, it is noticed that their analytical characteristics are similar only above pH 6, while at lower pH, these reagents react differently.

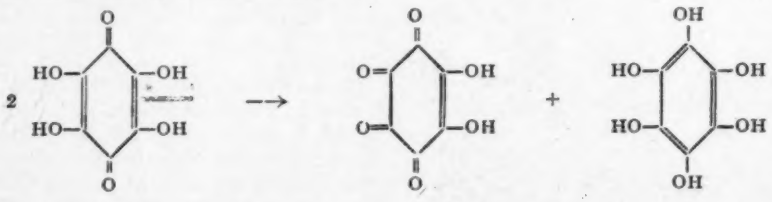
We have reported earlier[3] that tetrahydroxy quinone produces a blue precipitate with Th^{IV} and rare earths (Ce^{IV} oxidises it), and a red colour with ZrO^{++}. During the present investigation, it has been observed that this reagent gives green colour with Ti^{IV}; sodium rhodizonate on the other hand gives no colour with Th^{IV}, rare earths, ZrO^{++} and Ti^{IV}. When a solution of tetrahydroxy quinone containing Be^{++}, Mg^{++} or Al^{+++} is made alkaline with ammonia a red lake is produced. This reaction is not shown by rhodizonic acid.

On the addition of ammonium acetate or ammonia to a solution (yellow) of tetrahydroxy quinone, an orange colour, resembling that of sodium rhodizonate is produced. The solution reacts with $BaCl_2$ to give a red precipitate but does not react with $Th(NO_3)_4$. Also this solution does not give any lake with Be^{++}, Mg^{++} or Al^{+++}. Therefore at pH higher than 6 tetrahydroxy quinone fails to give its normal reactions. It appears that it is disproportioned to rhodizonic acid and hexahydroxy benzene.[5,6]

During the course of this investigation it was also observed that the yellow colour of tetrahydroxy quinone changes to blue in the presence of thorium. The minimum amount of thorium which can be identified by this reagent is 2 γ. Dilution limit is 1 : 25,000. When a drop of the test solution in the presence of a drop of 5 N acetic acid is treated with a drop of the reagent solution, no interference is observed even when 100 γ of uranium and rare earths are present. Ceric ions interfere and should be reduced to the cerous state. The presence of Ti^{IV}, ZrO^{++}, Fe^{++} and Fe^{+++} interferes with the above test.

Our thanks are due to Prof. T. R. Seshadri, F.R.S., for helpful discussions, and to the Atomic Energy Commission, India, for financial assistance.

Department of Chemistry, University of Delhi, Delhi-6, *August* 8, 1960. B. D. JAIN. S. P. SINGHAL.



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OBSERVATIONS ON THE PHARMACOLOGICAL ACTIONS OF THE WEAKLY BASIC FRACTION OF *VINCA ROSEA* LINN.—PART II

In an earlier communication, Bose *et al.* (1959) have reported on the chemical composition of *Vinca rosea*. It has been indicated therein that the weakly basic fraction contains 0·05% of reserpine.

The present investigation embodies a comparative pharmacological study of this fraction, with a view to find out whether its action is purely due to the presence of reserpine or any other active principle.

The drug was treated with chloroform till complete extraction. In order to remove more polar alkaloids, the solution was extracted with 0·1 N hydrochloric acid. The remaining chloroformic solution was then evaporated and the residue dissolved in 0·1 N sulphuric acid. The pH was adjusted to 5·5 and the concentration made up to contain 0·25 mg./ml. of reserpine. This fraction, which along with reserpine, also contained other weakly basic alkaloids, was used for pharmacological investigations.

The effect on blood-pressure and respiration was studied in 10 urethanised dogs by the usual techniques. The effect on the heart and the blood-vessels was studied in frogs and the action on the smooth muscles on rat's isolated intestine and uterus by standard isolated organ techniques.

Observations

C. N. S.—The fraction in a dose of 2·5 mg./kg. produced sedation in dog but the animal could be aroused and made to react to the stimuli. This was accompanied with myosis and relaxation of the nictitating membrane.

Cardiovascular System.—In a dose of 0·2-0·4 mg./kg., the fraction produced a sustained fall in blood-pressure, not affected by prior atropinisation (Fig. 1).

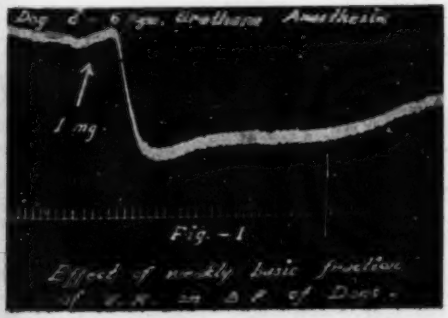

Fig. – 1

The peripheral vessels were not affected by the fraction as seen from the hind limb perfusion in frogs.

The fraction, in the dose range of 0·005-0·04 mg., depressed the frog heart, as seen in Fig. 2. In higher doses, it produced acute

Fig - 2

auricular dilatation and severe arrhythmia. Similar results were obtained with pure reserpine, in a dose range of 0·04 mg.

Electrocardiographic studies in dogs revealed mild bradycardia in a dose of 0·5 mg./kg. The action was more marked when the dose was increased to 1 mg./kg.

Respiration.—In doses of 0·2-0·4 mg./kg. the fraction slightly stimulated the respiration.

Smooth Muscles.—Decrease in tone and peristalsis of rat intestine, was produced by 0·06 mg./ml., completely antagonising acetylcholine induced contractions. A similar effect was also observed with reserpine in dose of 2-5 μg./ml.

The fraction also mildly stimulated the uterus and antagonised the action of acetylcholine in dose of 0·025 mg./ml., while reserpine elicited the same effect in a dose of 2-5 μg./ml.

(*a*) From the present investigation, it is evident that the weakly basic fraction of *Vinca rosea* produced sedation, miosis, relaxation of nictitating membrane, hypotension, bradycardia, and inhibition of isolated intestine.

(*b*) The peripheral vasculature was not affected.

(*c*) On comparing the above actions with reserpine, it is observed that the actions of the

weakly basic fraction are mostly due to its reserpine content.

Dept. of Pharmacology, M.G.M. Medical College, Indore, *June* 11, 1960.

B. C. BOSE.
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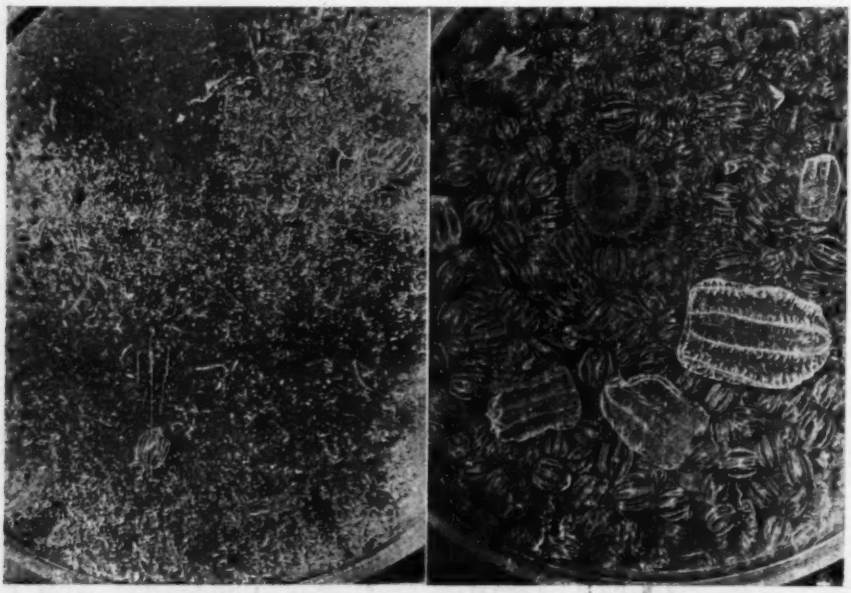
A NOTE ON THE SUDDEN OUTBURST OF CTENOPHORES AND MEDUSAE IN THE WATERS OFF BOMBAY

IN the course of investigations on zooplankton on the 27th October 1959, a sudden outburst of ctenophores and medusæ was noticed, the relative occurrence of which in the plankton may be seen in the two photographs (Figs. 1 and 2). medusæ continued to occur in large numbers up to the beginning of December.

TABLE I

Constituents	Percentage composition on different days				
	20—10—1959	24—10—1959	26—10—1959	27—10—1959	29—10—1959
Copepods ..	60	40	60	Negligible	Negligible
Mysis ..	35	40	10	30	10
Ctenophores ..	5	5	Negligible	50	40
Sagitta ..	Negligible	15	5	Negligible	5
Annelid larvæ ..	..	..	25	..	..
Crab zoea ..	..	..	..	20	..
Medusæ ..	..	..	..	..	40

During this period enquiries made with fishermen at Sassoon Docks revealed that there had been a sudden rise in the pomfret catches. Rege



FIGS. 1–2 Fig. 1. Plankton before the outburst of ctenophores and medusæ. Fig. 2. Showing the outburst of ctenophores and medusæ in the plankton.

The percentage composition of the various plankters for a few days preceding this outburst is given in Table I. The ctenophores and (1958) and Kulkarni (1958) have independently recorded that ctenophores and medusæ form a part of the food of pomfrets, *Pampus argenteus*

Euphr. Observations are being continued to ascertain if any possible correlation exists between the seasonal abundance of pomfrets with outburst of ctenophores and medusæ in the waters.

My thanks are due to Dr. C. V. Kulkarni, Director of Fisheries, Maharashtra State, Bombay, for necessary facilities.

Taraporevala Marine Biol. Res. Station, Bombay-2, *June* 4, 1960. MISS SHASHI CHOPRA.

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A NOTE ON THE POSSIBILITIES OF UTILISING QUINALDINE IN TRANSPORTING LIVE FISH

TRANSPORT of live fish in all its stages is a problem and it is invariably followed with mortality in spite of the care exercised during transport. Different tranquilisers like Sodium amytol, Urethane, Thiouracil, Tricane Methane Sulphonate have been used to anaesthetise fish with varying degree of success. Tricane Methane Sulphonate (M.S. 222) has been effectively used in the transport of fish in America with less of mortality. In our country use of anaesthetics in transport of live fish has not yet become popular and no systematic work on the use of tranquilisers has been undertaken.

Quinaldine (2-mythyl quinoline) a coal-tar product, which is not used in medicine has been reported to be effective as an anaesthetic (Bruce Muench) for fish at a concentration of 5 to 12 p.p.m.

Further work carried out here in the laboratory showed that quinaldine can be effectively and economically used in the transport of live fish in all stages. The observation made at the Freshwater Biological Research Station showed that the concentration required varied with the species of fish, size of fish, the nature of water and the time taken for transport. The relative tolerance varied widely, the range being 4 to 10 p.p.m. If the fishes are left for longer time at higher concentrations it has been found to be fatal. However at lower concentrations even if the effect is not much it was just sufficient to keep the fish from being active. It has been found that during transport quinaldine can be employed to reduce the activity and mortality of the fishes. By using quinaldine at 5 p.p.m. breeders have been successfully transported without any mortality in round tin carriers. The time taken for transport was about five hours and the number of fish in each container of 20 litre capacity being five of about 600 gm. size. The mortality in the transport of breeders without quinaldine has been as high as 100%.

It was also found that the use of the tranquilisers did not have any adverse effect on the breeders as the adult breeders transported were made to spawn successfully by pituitary injections. The tranquiliser did not affect the activity of the pituitary. The pituitary taken from fish transported by using quinaldine was effective in making the major carps breed. There is wide scope for the use of quinaldine by the fishery workers in fishery management.

Freshwater Biological Research Station, Bhavanisagar, *July* 2, 1960. M. V. NATARAJAN. V. RANGANATHAN.

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THE PETROLOGY OF THE CLASTIC DYKES FROM THE KARGALI AND BOKARO COLLIERIES, EAST BOKARO COALFIELD, BIHAR

THE Kargali and Bokaro are the two important collieries of the East Bokaro Coalfield, working the 80 to 100 ft. thick Kargali seam. In the Kargali colliery three clastic dykes have been found in Quarry No. 2 and one in Quarry No. 1, all cutting across the coal seam in an approximately vertical direction. A similar dyke cuts across the Kargali seam in Quarry No. 7 of the Bokaro colliery. The dykes vary in width from about 2 ft. to 1 ft. Clastic or sandstone dykes, as they are commonly known, have not been reported from this coalfield by any earlier worker.[1,2]

The dark colour, presence of micaceous flakes on the surface and a specific gravity varying from 2·45 to 3·60, are the characteristics of the dyke rocks.

Petrographically the dyke rocks are made up of two essential components—the detrital particles and the chemically precipitated cement. Out of the three dykes of Quarry No. 2, the Western and Eastern dykes show enormous variation in the average percentages (volumetric) of the two components and in the amount and size of the quartz (Table I).

TABLE I

Composition of the dyke rocks from Quarry No. 2, Kargali colliery

Dykes	Detritals	Cement	Quartz	Dominant size of quartz particles (mm.)
Western ..	54·30	45·70	50·15	·35–·15
Middle ..	21·53	78·46	19·13	·20–·04
Eastern ..	8·98	91·0	3·86	·15–·02

While bulk of the grains of quartz are sub-angular to subrounded, particles which are exceptionally angular, with sharp re-entrant angles, are not uncommon (Fig. 1). In contrast, particles with corroded margins are also present. The angularity of most of the quartz grains appears to have been accentuated as a result of replacement by the iron carbonate cement. Micas, rock particles and coal fragments, though much less in quantity, also share the framework. Some of the laths of muscovite have been torn apart along the cleavage planes, the intervening space being filled with the crystalline cement (Fig. 1). Fragments of coal have been incorporated into the dykes from the invaded coal seam.

In all the rocks studied, packing of the grains is not found to be 'normal'. Contacts per grain remain usually around 0·45 and sometime even less. Gaither[3] proposes that in a freshly deposited sand there are approximately 0·85 contacts per grain. When many grains are not in contact with each other, the framework is 'disrupted' or 'broken' (Pettijohn[4]). The framework in all the dyke rocks, therefore, is disrupted.

The chemically precipitated siderite forms the principal cement in all specimens studied. It occurs most commonly as fine crystalline mosaic being fresh and unaltered. Small patches of clay which are found associated with it, most probably, represent remnants of the original matrix of the rock. Siderite often replaces the detrital grains. For example, we find in the Eastern dyke, the proportion of the cement is as much as 91·0% (Fig. 2). Such a rock may well be called *Ironstone*. The Western dyke, on the other hand, may be described as sideritic sandstone.

It appears that the material constituting the dykes was injected into the pre-existing fissures

FIG. 1, ×54

FIG. 2, ×54

of the coal seam in the form of a thick slurry. The disrupted framework has been considered here as essentially penecontemporaneous, though accentuated later on by the encroachment of the chemical cement on the original matrix as also on the detrital components of the rock. In the absence of positive evidences, it is tentatively suggested that the slurry was injected into the fissures from the top.

I am grateful to Prof. P. N. Ganju, under whose guidance the main work on the Petrology of Bokaro coals is being pursued. Thanks are also due to Mr. V. K. Srivastava, for several useful discussions.

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Aligarh, *May* 14, 1960.

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BOTANICAL BASIS OF RED-SPIDER RESISTANCE IN TEA

CELLS with deposits of calcium oxalate in the phloem parenchyma of the tea plant (*Camellia sinensis* L.) are well known. A standard estimate of their frequency,[4] described as "phloem index", is indicative of an intensity of various process within the plant.[1,2] The phloem index of any particular plant can be supposed to have an innate, mean value, with a comparatively simple inheritance[6]; and another immediately apparent value, which is determined by environmental conditions acting within genetic limits.[1] It is the object of this short paper to show that the innate phloem index of a tea plant is a measure of its resistance to infestation by red-spider (*Oligonychus coffeæ* Nietner).

Six tea plants from two commercial jats were multiplied vegetatively to give six clones. The clones were repeated in two blocks, as plots of 18 bushes. Half of each plot was shaded by bamboo mesh screens, like those used in other experiments at Tocklai,[7] giving a light intensity approximately 50% of that on the unshaded half-plots. The six clones were a source of cuttings for separate experiments on vegetative propagation. The two blocks, therefore, were treated according to routine methods for cutting stools,[5] excepting that ammonium sulphate, at the rate of 90 kilos of nitrogen per hectare, was applied differentially to permit the analysis of variance in Table I.

In January 1960, red-spider infestation of the growth made in response to October pruning, had reached an advanced stage, and differed markedly between clones. We therefore estimated the degree of infestation according to the subjective scoring method used by G. M. Das.[3] By this method, infestation can vary from 0-4. Table I gives the analysis of variance of red-spider infestation, the corresponding analysis of variance of phloem index, and the correlation coefficients between the two factors. It is evident that genetically determined phloem index is significantly associated with the observed red-spider infestation ($r = -0{\cdot}82$: $P < {\cdot}05$) and, within the limits, the observations show that the higher the innate phloem index of a tea plant the greater its resistance to attack by red-spider.

TABLE I

Analysis of variance of red-spider and phloem index, and the correlations between these two factors

(One, two and three asterisks indicate significance at the ·05, ·01 and ·001 levels respectively)

Source of variance	D.F.	Red-spider Mean square	Phloem index Mean square	Correlation coefficient
Blocks	1	0·614	4·44	..
Shade (S)	1	7·881	1371·74	..
$Error_1$	1	0·057	44·08	..
Clones (C)	5	2·033*	4631·09***	−0·822*
C×S	5	0·549	35·51	−0·561
$Error_2$	10	0·610	17·74	0·049
Ammonium sulphate (N)	1	0·888*	599·25**	..
N×S	1	0·021	521·40**	..
N×C	5	0·052	115·42	0·275
N×C×S	5	0·077	221·44*	0·568
$Error_3$	12	0·145	44·35	−0·237
Total	47	..	..	..

It has previously been shown that phloem index is indicative of hybridity between the taxa generally known as *Camellia sinensis* var. *sinensis* and *C. sinensis* var. *assamica*.[8] Taxonomically, the clones which gave the results in Table I fall within the nominal limits of var. *assamica*. The nature of the relation between phloem index and red-spider (Fig. 1) might be the same, or different, in var. *sinensis* (and in the Southern form of var. *assamica*), but some relation could be expected. In this connection it is to be noted that every individual with the external facies of var. *assamica* can be supposed

to have its homologue in an individual of var. *sinensis*, both of them having the same phloem index.[8]

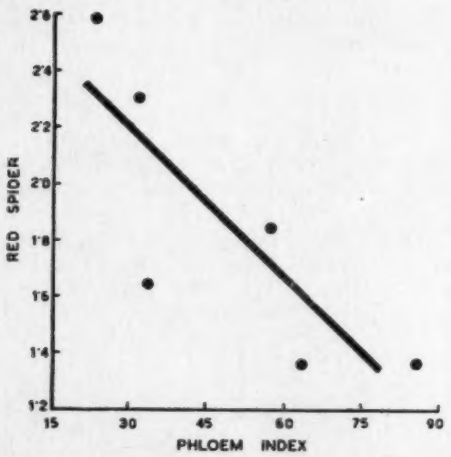

FIG. 1. Regression of red-spider infestation on phloem index of clones. The regression equation is $y = 2{\cdot}68 - {\cdot}017x$ (linearity significant at the ·05 level).

Although the major conclusion to be drawn from the present paper relates to the innate phloem index, and thus to the possibility of breeding for red-spider resistance, yet the correlation coefficients, associated with the analysis of variance in Table I, suggest that better replication, and possibly, more precise determination of red-spider, might demonstrate some statistically significant associations between treatment-induced phloem index and treatment-induced red-spider : in particular, there is the possibility of the immediate, obvious, phloem index of a tea plant, being some measure of an environmental status that could be relevant to red-spider infestation.

The authors are grateful to Dr. G. M. Das, Senior Entomologist, Tocklai, for help with the estimates of red-spider infestation. We are indebted also to Mr. L. R. Saikiah for the statistical computation, and to Mr. H. Ferguson, Director of Tocklai, for permission to publish.

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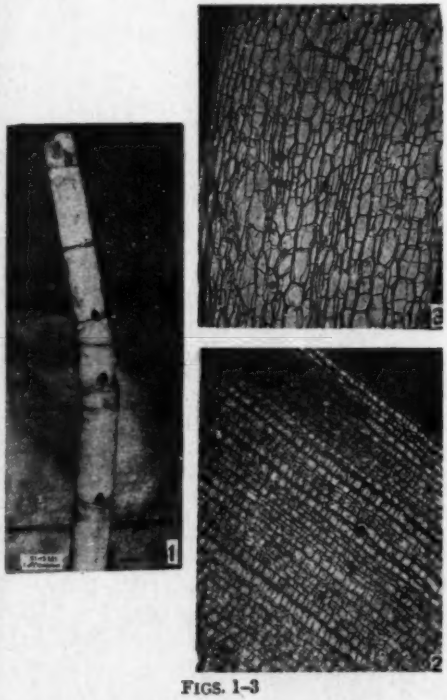
ANATOMICAL PECULIARITIES OF TWO INTERESTING CLONES OF *SACCHARUM OFFICINARUM* L.

ARTSCHWAGER AND BRANDES[1] have recorded detailed morphological descriptions of many of the original clones of the 'Noble' canes belonging to *S. officinarum* L., the original home of which is the Melanesian islands, especially, New Guinea. The normal shape of the internode in this species is described as either cylindrical, tumescent or conoidal and the internodes as symmetrically aligned. However, deviations from this normal form have been noticed in certain varieties. Martin[2] (quoting Lyon) describes as a monstrosity the abnormal arrangement of the internodes in certain varieties. Buzacott[3] has mentioned among others, the two varieties 51 N.G. 121 and 51 N.G. 131 having peculiar internodal shapes, as curiosities among the New Guinea collections. In this note, the anatomical peculiarities associated with the unusual internodal development in the above two varieties are pointed out.

The variety 51 N.G. 131 has characteristically oval-shaped internodes giving the cane stalk a beaded appearance. The striking zigzag alignment of the internodes results from unilateral bulging of successive internodes in opposite directions. The intercalary meristem at the bottom of the internode, which normally is a well-defined zone known as the growth ring and is responsible for production of new cells and their elongation is noticed, in this variety, to be diffused and tending to merge with the main internodal region. A longitudinal section of an internode shows a peculiar orientation of the vascular bundles. These instead of running a straight course, as is normally met with, take a curve slanting towards the bulged part of the internode. Along with the bundles, the ground tissue also takes a slightly curved course. In the internode above, wherein the bulge develops on the opposite side, there is corresponding slanting disposition of the tissues towards the enlarged side. Presumably, in the variety, there is a secondary stimulation leading to unilateral growth and formation of a bulge on one side.

The other variety 51 N.G. 121 is characterised by the occurrence of short, lop-sided internodes,

interpolated at intervals, amidst normally developed internodes (Fig. 1). Such unilaterally elongated top-sided joints usually occur in groups of two at a time and at two or three places along the length of the cane stalk. These internodes are a constant feature of the variety even under varying environmental and cultural conditions. A longitudinal section of the lop-sided internode reveals that at the unilaterally enlarged part, there is a marked linear elongation of cells (Fig. 3), as compared to the unelongated part of the same internode (Fig. 2), where the cells are



FIGS. 1-3

small, isodiametric and comparatively unthickened. This would show that in this part the cells still retain their meristematic condition, while those in the elongated portion of the same internode have attained maturity, as indicated by the linear elongation of the cells and the thickening of cell-walls. The length of the latter cells as compared to the former is about 3·5 times. The differential histological gradients in the same phytomer (unit of a grass culm) involving an accelerated maturation and hypertrophy of cells on one side and retention of the meristematic condition and suppression of further growth on the other, results in the formation of a lop-sided internode.

Such anatomical changes have been previously observed by the author[4] to be associated with unequal elongation of the intercalary meristem (growth ring) of lodged sugarcanes, in response to geotropic (negative) stimulus.

I am grateful to Dr. N. R. Bhat, Director, and Dr. J. T. Rao, Botanist, for constant encouragement and guidance.

Sugarcane Breeding Inst., Coimbatore-7, *May* 12, 1960. A. S. ETHIRAJAN.

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EFFECTS OF GAMMA-RAYS ON GERMINATION AND GROWTH IN SOME SPECIES AND HYBRIDS OF *SACCHARUM*

TYSDAL[1] reported that "sugarcane buds exposed to 4000 *r* were either killed or seriously injured and those exposed to over 4000 *r* were all killed". It is not clear whether the above findings were based on a study of one variety or more. From a study of the effects of gamma-rays on buds of only one hybrid sugarcane variety Co. 419, Panje and Prasad[2] inferred that the lethal dose might be in the region of 14000 *r*.

With a view to study the reaction of the different species of *Saccharum* and some hybrid varieties to varying dosages of gamma-rays and find out whether they react alike or differently, advantage was taken of the Cobalt^{60} gamma irradiation facility afforded in the Atomic Energy Section of the United States Exhibit at the World Agriculture Fair held recently at Delhi and twelve one-budded cuttings of one representative variety in each of the following five species of *Saccharum* and three hybrid sugarcane varieties were got irradiated. In all 84 buds were irradiated for each variety except *S. robustum* and 624 in all.

Sl. No.	Species	Variety
1	*S. officinarum*	.. Z.W. Cheribon
2	*S. spontaneum*	.. S.E.S. 205 A
3	*S. barberi*	.. Mungo
4	*S. sinense*	.. Uba
5	*S. robustum*	.. 28 N.G. 251
6	Hybrid sugarcane	.. Co. 312
7	"	.. Co. 449
8	"	.. Co. 1228

Excepting in *S. robustum*, seven treatments were given, *viz.*, 500 *r*, 1000 *r*, 2000 *r*, 3000 *r*, 4000 *r*, 5000 *r* and 10000 *r*. The cuttings after irradiation were planted in pots and weekly observations were recorded on germination, height, leaf area and mutations, if any. At the end of two months the plants were taken out of the pots and the root development studied.

Mean measurements recorded on the control and irradiated plants are given in Table I.

TABLE I

Data on germination, height, leaf area and features of root development

Dosage	Mean germination (per cent.)	Mean height at 60 days (cm.)	Mean leaf area at 60 days (sq. cm.)	Features of root development
Control ..	84·7±3·4	25·5±2·5	88·5±7·0	Good sett and shoot root development
500 *r* ..	88·6±4·3	24·5±1·8	80·7±6·3	"
1000 *r* ..	86·9±4·7	23·4±1·6	68·6±5·4	"
2000 *r* ..	91·7±3·4	22·0±2·0	72·3±6·7	"
3000 *r* ..	87·4±5·2	19·8±2·9	51·9±6·8	"
4000 *r* ..	65·3±7·4	14·9±3·2	36·3±8·4	Fair sett root development in some; in others no sett root development and in rare cases shoot roots formed
5000 *r* ..	55·7±8·9	14·2±2·2	38·2±8·2	No sett root development; in rare cases few shoot roots formed
10000 *r* ..	9·7±8·2	6·8±1·7	6·8±2·6	

The following were in general the indications though individual varieties reacted somewhat differently in different treatments. The germination of buds in the treatments up to 3000 *r* was more or less equal to that of control and in some cases slightly superior. A sudden fall in germination was noticed in dosages 4000 *r* and above, it being as low as about 10% in 10000 *r*. Varieties Co. 449 (nil), Mungo (5·6%) and Co. 1288 (7·5%) were very adversely affected by the dosage.

The data on height measurements indicate in general for the varieties little difference in growth between the control and treated plants up to 3000 *r*. There was a drop beyond 3000 *r* being marked at 10000 *r*. In the varieties Mungo, Uba, and Co. 312 no plants got established in 5000 *r*, or 10000 *r* treatments though one or two buds did germinate.

The leaf area showed a tendency to diminish from 500 *r* upwards and came down to about 60% of control at 3000 *r*.

The study of root development showed certain interesting features. In general, the varieties recorded normal root development up to 3000 *r*. Most of the root initials developed sett roots and there was the normal functioning of shoot roots as well. In many cases, at 5000 *r* and 10000 *r* and in some varieties even at 4000 *r* the root initials were scorched, produced knobs and turned black. There was thus no development of sett roots.

Some of the sprouted buds in the treatments 4000 *r* and over dried up after about four weeks. This seems to be due to the non-formation of sett roots consequent on damage to the root initials. Certain of the shoots even at these high dosages got established as shoot roots were formed early.

No mutations were visible except stripes on the leaf and leaf-sheath in some shoots in Mungo at 3000 *r* and 4000 *r*.

From the above studies, it would appear that the upper limit of safe dosage for normal germination and growth of *Saccharum* material would, in general, be about 3000 *r*.

The material has been planted in the field for further observations.

Thanks are due to Dr. N. R. Bhat, Director, for help and guidance and Shri R. Narasimhan, Assistant Botanist, Sugarcane Substation, Karnal, for getting the material irradiated.

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May 27, 1960.

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J. T. RAO.

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CHROMOSOME ASSOCIATIONS IN HAPLOID *GOSSYPIUM BARBADENSE*

AMONG the X_1 generation plants of a Sudan variety of *Gossypium barbadense* L. ($2n = 52$) treated with 36,000 *r* of X-rays, a plant with dwarf habit, small leaves and small flowers

with aborted anthers was found (Fig. 1). On cytological examination this plant was found to be a haploid (technically a poly-haploid) with $2n = 26$. The mode of origin of this haploid is not clear. Harland[1] has reported that haploids occur occasionally in *G. barbadense*. Hence it is possible that the haploid is of spontaneous parthenogenetic occurrence, though the possibility that it arose as a result of X-ray induced somatic reduction cannot be altogether precluded since such cases are also known.[2]

Meiosis was studied in the microsporocytes of the haploid plant. Among 100 cells at diakinesis and meta-anaphase, none had any bivalent. All the 26 chromosomes remained as univalents (Fig. 2). A single sporocyte had 26 bivalents. Non-disjunction during premeiotic mitosis could give rise to such a diploid cell. The formation of 26 bivalents in the diploid cell indicates that the haploid complement is a complete one. Webber[3] and Beasley[4] have studied meiosis in haploid plants of *G. barbadense*. While Webber found 2 bivalents in two cells and 1 bivalent in one cell in the haploid studied by him, Beasley did not find any pairing in his material. The behaviour of the haploid plant studied by us is thus similar to that reported by Beasley.

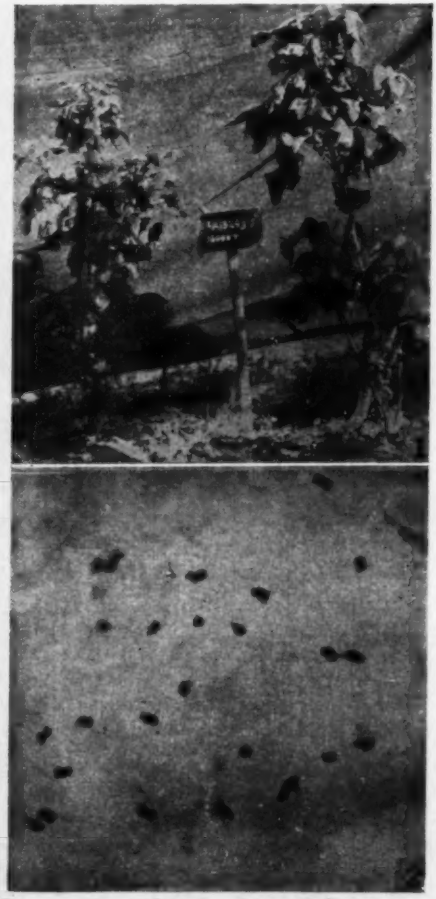

FIG. 1. Normal (right) and haploid (left) plants of *G. barbadense*. Fig. 2. M_1 in the haploid with 26 univalents. Note the secondary associations among the univalents.

An interesting feature of diakinesis and metaphase in the haploid was the occurrence of specific secondary associations of the end-to-end, side-to-side and end-to-side types among the univalents. The frequency of univalent associations was critically analysed in 25 clear cells. In 12 of these 1 big and 1 small univalents were associated. The other types of associations included 2 big and 1 small, 3 big and 1 small and 3 big univalents.

In the chromosome complement of tetraploid *Gossypium* species, one set of large and one set of small chromosomes can be recognised. The large and small chromosomes are supposed to be derived from the Asiatic (A) and New World (D) genomes respectively. The occurrence of secondary association between some large and small chromosomes in the haploid studied by us may be interpreted as indicative of some homology between a few A and D genome chromosomes. Of still greater interest is the association of several large univalents among themselves. Until recently, the tetraploid cotton species were believed to be capable of tolerating only minute deficiencies and duplications and not whole chromosome deficiencies. Kammacher *et al.*[5] have, however, recorded the occurrence of a viable quadruple monosomic in a primitive strain of *G. hirsutum* and from cytological studies they have suggested that the four chromosomes lost all belong to the A genome. Their studies further show that monosomics involving large chromosomes are recovered and transmitted more frequently than those involving small chromosomes. This would suggest a higher degree of duplication among the A genome chromosomes and our observation that at the haploid level secondary associations frequently occur among the large chromosomes would support this view. Cytological studies in haploid plants of New World tetraploid *Gossypium* species from this point of view would hence be interesting.

We are indebted to Dr. B. P. Pal and Dr. A. B. Joshi for their interest in this study.

Division of Botany, Indian Agricultural Research Institute, New Delhi-12, *June* 20, 1960.

G. R. K. SASTRY.
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SOME NEW RECORDS IN INDIAN SOIL FUNGI

INVESTIGATIONS on the soil micro-fungi of Uttar Pradesh both from taxonomic and ecological standpoint have been in progress in this laboratory and during this study about 150 species have so far been isolated. These include members of Acrasieæ, Phycomycetes, Ascomycetes, Fungi Imperfectii, Mycelia Sterilia and many other forms whose identification is in progress. A scrutiny of the available literature showed that some of these forms were hitherto unrecorded from soil or from Indian soils. This preliminary report includes micro-fungi which are either new reports from soil or new records from Indian soil.

The soil samples for this study have been collected from areas randomly selected, some essential information regarding which is summarised in Table I.

TABLE I

Locality	Details of the locality	No. of soil samples examined	pH range of the soil samples	Soil type
A	Areas in the vicinity of Lucknow	60	5·8– 8·5	Cultivated, uncultivated and 'usa'
B	Village Salethu, Dist. Rae Bareli	8	6·9–10·0	Cultivated and 'usar'
C	Pallia, Dist. Kheri	6	6·2– 6·8	Uncultivated

Table II gives the list of forms which are either new reports from soil or new records from Indian soil.

The species of *Heterosporium* isolated here differs from the two species which have so far been reported from soil.[1–3]

Raper in a personal communication informed Singh (1947)[4] that he had isolated species of *Dictyostelium* from Indian soils. Except for this brief report nothing was known till now

TABLE II

Name of the fungus	Locali A	B
**Dictyostelium mucoroides* Bref.	+	+
**D.* "*polystelium*" Cohen	+	–
**Polysphondylium violaceum* Bref.	+	+
†*Chaetomium pachypodioides* Ames.	+	–
†*Penicillium clavigerum* Deme ius.	+	–
**Pyrenochaeta decipiens* Marchal.	+	–
†*Heterosporium* Klotzsch Spp	–	–
†*Colletotrichum dematium* (Pers. ex Fr Grove)	+	
†*Pestalozziella* Sacc. et Ellis spp.	+	–

* Reported for the first time from I dian soils.
† Reported for the first time from soil.

about the members of Acrasieæ inhabiti soils of this country. A detailed study h revealed the presence of three members of th group so far, belonging to two genera, i *Dictyostelium mucoroides* Bref., *D.* "*polystelium* Cohen and *Polysphondylium violaceum* Bre Sorocarps resembling very much those *D. minutum* Raper have been observed in ma of the soil isolates, but so far it has not bee possible to get this form in pure-mixed cultur

The junior author expresses his indebtedne to the Council of Scientific and Industri Research for the award of a fellowship duri the tenure of which this work has been don

Department of Botany, Lucknow University, Lucknow, *June* 11, 1960.

J. N. RAI.
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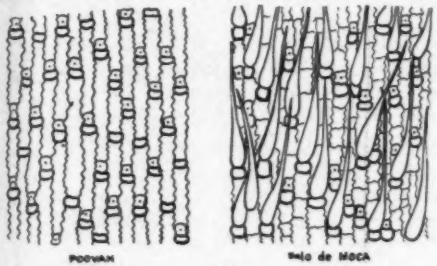
STEM EPIDERMAL PATTERN OF PUBESCENT CULMS IN CERTAIN CLONES OF *SACCHARUM OFFICINARUM*, L.

PUBESCENCE of culms (entire internode) is ve rare in the species of *Saccharum*. Buzacot was the first to report the occurrence of hai on the culm in 51 N.G. 89, a clone of *S. offic narum*. Later, Artschwager and Brande noticed pubescence on culms in six of the 3 clones of *S. officinarum* studied and describe by them. A study of the stem epidermal patte of five pubescent clones of *S. officinaru* revealed certain interesting features differin from the normal pattern and these are presente in this note.

The normal stem epidermal pattern in the species of *S. officinarum* (Fig. 1) is the



FIGS. 1-2. Stem Epidermal Pattern.

occurrence of "long cells" (named as such in view of their length) in regularly disposed straight rows (as in grasses in general) with interspersed short cell groups made up of "cork and silica cells". The long cells constitute the greater part of the epidermal area and each cell is about 180 microns in length. No exodermal elements are noticed.

In the five pubescent clones under discussion long, unicellular, vacuolate hairs developing from the outstretched walls of the silica cells were present in addition to the long and short cells. In the heavily pubescent clones, over 60% of the silica cells were transformed into hairs and the "long cells" were unusually short. In Table I are given the data recorded on number of silica cells (separately as silica cells and hairs), and cork cells per sq. mm. and the length of the long cells in the five clones as also in a non-pubescent typical *S. officinarum* clone, Poovan.

have been reduced to about 1/7 of their normal length (Fig. 2). The occurrence of such short "long cells" has been reported by Pratt[3] as noticeable only in transition zones (nodes, sheath bases, blade bases) where the cells are in a meristematic condition and unusual in mature internodes. The name "long cells" is a misnomer in these cases.

According to Pratt[4] in the growth of the epidermal cells of grasses, "during the stage of elongation, the long cells elongate and their length may be centupled in a short time while the short cells remain passive". A steep sigmoid shape of growth curve has been indicated by him covering the four stages of cell activity, *viz.*, multiplication, differentiation, enlargement (increase in volume by elongation) and maturation, the stage of elongation contributing to the steepness of the curve. In the clones studied "the stage of elongation" wherein rapid growth of long cells is said to take place is not demarcated and the steepness of the curve is not obtained.

Thus the epidermal pattern in the clones is rather unusual for grasses and the heavy pubescence of the culms is the direct consequence of the abnormal pattern of the stem epidermis. Vegetative propagation of the clones maintains this character in tact and the character is suitable for inheritance studies.

Thanks are due to Dr. N. R. Bhat, Director, for interest and encouragement and to Dr. J. T. Rao, Botanist, for guidance in the progress of the work and going through the manuscript.

Sugarcane Breeding Inst., U. VIJAYALAKSHMI.
Coimbatore-7, A. S. ETHIRAJAN.
July 14, 1960.

TABLE I

Number of silica cells and cork cells per sq. mm. and length of "long cells" in microns

Sl. No.	Name of clone	No. of cork cells	No. of silica cells		Length of "long cells"
			Normal	Hairs	
1	Pelo de Moca* ..	246·4±0·79	89·0±0·41	118·4±0·45	24·8±0·48
2	R.G. Ventre ..	167·8±0·64	7 ·0±0·34	98 6±0·35	28·8±0·56
3	Lehu 75 ..	254·4±0·83	128·2±0·44	45·8 ±0·48	46·0±1·18
4	51 N.G. 89 ..	159·0±0·55	137·6±0·39	23·2±0·30	67·2±0·89
5	N.C. 32 ..	148·4±0·65	12·2±0·17	19·8±0·22	75·8±1·71
6	Poovan ..	117·8±0·69	72·4±0·36	Nil	184·6±5·32

* Varieties arranged in the descending order of pubescence.

As will be seen from Table I in general, the number of silica cells (normal + hairs) and cork cells increases with increase in the density of pubescence, while the length of the long cell decreases. The number of silica and cork cells in the heavily pubescent varieties is 2-3 times that in the normal Poovan while the "long cells"

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FLOWERING BEHAVIOUR AND ANTHESIS OF *CURCUMA LONGA* L.

THE spike exercised from the leaf-sheath consists of numerous bracts of which the lower one or two and a few at the top are barren. Floral bracts are green while those at the top are white or, rarely, purple. The main axis of the inflorescence is never terminated by a flower but continues to grow up to a length of 6 inches and give off bracts in acropetal succession. Each bract in its axil bears generally more than two flowers which come out in succession. Each flower is enclosed by a hyaline bract. Calyx is short, tubular and toothed (2–3-lobed). Corolla tube is narrow below and broad above. Petals 3 in number, gamopetalous, free at the top, æstivation is imbricate, the median petal is broad and hooded. Lateral staminodes are petaloid. The broad labellum is deep yellow in colour. The two sterile stamens attached at the base of the pistil are very reduced structures. The two-lobed fertile anther with two long spurs is attached to the petaloid filament in between the two lateral staminodes. Stigma capitate, slightly two-lobed, transversely oblong stigmatic surface. Style passing through the two lobes of fertile anther comes above such that the stigma remains just above the anther lobes and on the dorsal side of the spurs. Ovary globose, hairy at the top, trilocular with many ovules in each locule.

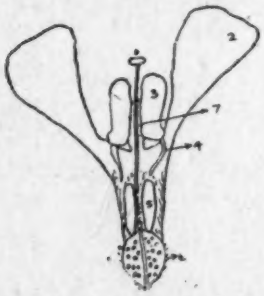

FIG. 1

FIG. 2

FIG. 1. (1–7 L.S. flower): 1. Stigma. 2. Lateral staminode. 3. Fertile stamen. 4. Spur. 5. Sterile stamen. 6. Ovary. 7. Connective of fertile anther.
FIG. 2. (1–5 Arrangement of stamen and staminodes): 1. Ovary. 2. Sterile stamens. 3. Fertile stamen. 4. Lateral staminode. 5. Labellum.

Flowering period ranges from June to October. The flowers in the spike open in acropetal succession. The second series of flowers open, after the first flush reaches nearly halfway up the spike. The first flush of flowering in a spike is generally completed within 5-12 days.

Opening of flowers takes place in the morning between 6 and 6-30 a.m. at a temperature of about 24° C., during which period the humidity of the atmosphere remains above 70% in the locality.

Dehiscence of anthers takes place just at the time of flower opening and pollination is observed to be brought about by insects.

The structure and position of the spurs of the fertile anther are such that it favours cross-pollination by insects. As the insect enters the flower, it pushes the spurs inside so that the dehisced anther touches and dusts the back of the insect after which the stigma comes in contact with the posterior part of the back of the insect. While the insect comes out, the stigma first detaches from the body of the insect, then from the anther lobes. Hence there is no possibility of self-pollination.

Turmeric Research Station, G. Udayagiri, Orissa, *January* 12, 1960.

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VARIETAL REACTION OF JOWAR TO GRAIN SMUT IN UTTAR PRADESH

JOWAR (*Sorghum vulgare* L.) is an important millet crop in Uttar Pradesh and every year there is a loss in grain yield of about 2–5% due to grain smut caused by *Sphacelotheca sorghi* (Link) Clinton. Occasionally a few fields show up to 65% grain smut infection. Thus with an average loss of even 2%, nearly 12,139 tons of grain is lost annually due to grain smut.

Work on the successful control of grain smut by fungicidal seed treatment has been reported from several States in India and abroad but it will be still desirable to obtain varieties resistant to grain smut. The work of testing varieties of jowar against grain smut with a view to evolve resistant varieties has been in progress in Uttar Pradesh for a long time.

Mehta *et al.*[1] reported the results of testing 27 promising varieties or cultures of jowar against grain smut for the period 1950–1952. This work was continued for a further period of 5 years (1953–1957) with 29 more varieties and cultures of jowar. All varieties were selected in Uttar Pradesh except E.C. 1603 and Milo 4 which belong to the United States of America. The technique of inoculating the seed before sowing and counting the healthy and smutted heads from plants raised from such seed was the same as reported earlier by Mehta *et al.* As a result of repeated tests for resist-

ance to grain smut, the jowar varieties and cultures are grouped as follows :—

Resistant (Below 1% infection)—53/1, 4101, 31 B.

Moderately resistant (Below 5% infection).—53/2, 4404 A, 4403 B, 30 D, T 3 (4403), Milo 4.

Moderately susceptible (Below 10% infection).—48/2, 50/1, 4102, E.C. 1603, 5 T 10 E.K.

Susceptible (Below 15% infection).—48/11, 52/7, 4108, 4106 A, 8 B, 8 B-11, 9 E.K.

Very susceptible (Above 15% infection).—51/4, 4105, 4109, 4106 B, 48/1 B, 30 C, T 18.

It is evident from the results that three cultures, *viz.*, 53/1, 4101 and 31 B proved to be highly resistant and six other cultures are moderately resistant. These cultures are not agronomically superior to the prevalent varieties but some of them are now being used by the Economic Botanist as resistant parents in a hybridization programme for combining desirable grain and yield characters with resistance to grain smut.

Thanks are due to the Economic Botanist (Oilseeds, Millets and Pulses) to Government, Uttar Pradesh, Kanpur, for the supply of jowar varieties and cultures.

Laboratory of the Plant Pathologist, Govt. of U.P., Kanpur, *May* 9, 1960.

R. S. Mathur.
S. C. Atheya.
J. S. Jain.
S. C. Mathur.

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RESISTANCE OF GRAM VARIETIES TO *FUSARIUM* WILT IN UTTAR PRADESH, 1949-1958

Gram (*Cicer arietinum* L.) is an important crop of Uttar Pradesh. Wilt of gram, caused by *Fusarium orthoceras* var. *ciceri* Appel. and Woollenw. is responsible for about 10% loss to the crop every year.

Since *Fusarium* wilt of gram is a soil-borne disease, the most satisfactory control is the use of resistant varieties. Ninety-five varieties, obtained from the Economic Botanist (Oilseeds) to Government, Uttar Pradesh, Kanpur, were tested during the period 1949-58 in a wilt sick plot which was regularly fed with large quantities of chopped straw and stubbles of completely wilted gram plants collected from different localities of the State. Before sowing the seed, the debris inoculum was spread uniformly in the wilt sick plot. This inoculum was also added to the furrows at the time of sowing. Each variety was sown in two rod rows 18' long and replicated four times. When germination was complete, the total number of plants was counted and subsequently wilting plants of each variety were uprooted at regular intervals and counted. Samples of such wilted plants were also examined in the laboratory and isolations of fungi made from them in order to confirm the causative organism.

A summary of results is given below :—

Resistant (Wilted plants up to 10%)—4338-15 (106)* (except during 1954-57 when the range of affected plants was 21·8-34·7%), 4317 (100), 4317-28 (93), 4318-12 (88), 4313-2, 93 and 4409-9 (101).

Moderately susceptible (Wilted plants up to 20%).— 4326-8 (345) and 4320-26.

Susceptible (Wilted plants up to 50%).—4324-2, 91, 95, 98, 102, 118, 257-1, D-51, 44-4, 4, 64, 88, 190, D-69, D-59, D-66, 32-1, 32-2, 491-16, 730-2, 666, 605-15, 394/2, 678, 497-1, 742-1 and 728-8.

Highly susceptible (Wilted plants up to 75%).—Nagina, 44-2, 256, 110, D-65, D-70, 252-84, 252-92, 252-128, 500-6, 491-15, 710-2, 690-11, N.P. 25, 256-19, D-53, D-63, D-337, 256-30 and 524-8.

Most susceptible (Wilted plants up to 100%) T. 251 (T1), Banda, 257-8, 252-197, 45, 76; 78, 84, 94, 109, 125, 167, 176, 195, 197, 211, 305, 322, D-308, D-67, 256-8, 252-93; 44-12, 256-34, 20, 24, 41, 49, 252; 253; 257, 44-9, 44-13, 256-18, 44-10, 44-7, 492-1, T 87, and 177-11.

Laboratory of the Plant Pathologist, Govt. of U.P., Kanpur, *April* 23, 1960.

R. S. Mathur.
J. S. Jain.
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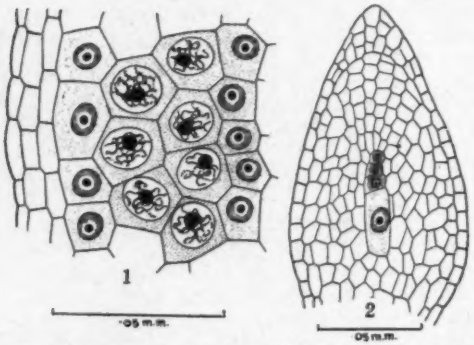
* Figures within small brackets indicate the final strain numbers of hybrids and varieties assigned by the Economic Botanist (Oilseeds, Millets and Pulses) to Government, Uttar Pradesh, Kanpur.

EMBRYOLOGY OF STAPHYLEACEAE

The family Staphyleaceæ since the publication of Schnarf's work[1] has not received the attention of embryologists. The present paper deals with the embryology of *Turpinia nepalensis* Wall.

The anther structure shows an epidermis and three wall layers (Fig. 1). The innermost layer functions as the tapetum which is of the secretory type, contrary to the earlier reports.[1] The tapetal cells become 2-nucleate by the time

the pollen mother cells begin to undergo meiosis. These remain conspicuous even after the pollen grains are formed in the anthers. The fibrous endothecium is developed from the hypodermal wall layer while the middle layer becomes crushed during development.



FIGS. 1–2. Fig. 1. L.S. anther lobe showing the sporogenous tissue and tapetum. Fig. 2. L.S. ovule showing the megaspore tetrad, parietal layers and nucellar cap. Integuments not shown.

Meiosis in the pollen mother cells is normal. Cytokinesis takes place by furrowing. Pollen tetrads are tetrahedral. The pollen grains are 2-nucleate at the time of shedding.

The ovary is superior, 3-carpellary, syncarpous and 3-locular. The ovules are crassinucellate, bitegmic and anatropous. The integuments do not fit in closely but leave a space between them and the nucellus. The micropyle is formed by both the integuments. The primary parietal cell by repeated divisions forms 6–8 parietal layers. The cells of the nucellar epidermis undergo periclinal divisions in the micropylar region and form the nucellar cap (Fig. 2) such as reported in Burseraceæ, Simaroubaceæ, Meliaceæ and Rutaceæ.[2–5]

The primary archesporium is single-celled and hypodermal. A primary parietal cell is cut off by the archesporial cell before it functions as the megaspore mother cell. The megaspore mother cell as a result of meiosis gives rise to a linear tetrad of megaspores (Fig. 2). The lowermost megaspore is functional and gives rise to an embryo-sac according to the polygonum type while the upper three megaspores degenerate during development. The embryo-sac shows the usual organisation. The synergids show hooks and filiform apparatus in the apical region. The embryo-sac enlarges during development and as a consequence some of the parietal layers become crushed.

I wish to express my thanks to Prof. M. Sayeeduddin for encouragement and Dr. M. A. Salam for his kind interest.

Department of Botany, Osmania University, Hyderabad-7, *April* 28, 1960.

L. L. NARAYANA.

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CHROMOSOMES OF *BEROSUS INDICUS* MOTS. (COLEOPTERA, HYDROPHILIDAE)

THE chromosomes of only four species[1–3] belonging to the family Hydrophilidæ have been reported so far. Recently the author had an opportunity to investigate the chromosomes of three more species[4] *Hydrous indicus*, *Sternolophus rufipes* and *Berosus indicus*. The results are summarized in Table I in comparison with

TABLE I

Species	Chromosome number		Sex Chr.	Author
	2*n*	*n*		
Hydrous acuminatus	30 s	15 (I, II)	X–*y*	Asana *et al.*, 1942
„ *piceus*	.. 30 s	15 (I)	..	Arnold, 1908
„ *triangularis* Say	30 s	15 (I, II)	X–*y*	Smith, 1953
Tropisternus lateralis Fab.	..	9 (I, II)	X–*y*	„
Hydrous indicus Bedal.	30 s	15 (I, II)	X–*y*	Agarwal, 1960
Sternolophus rufipes Fabr.	18 s	9 (I, II)	X–*y*	„
„	.. 18 o	..	X–*x*	„
Berosus indicus Most.	18 s	9 (I, II)	X–*y*	„

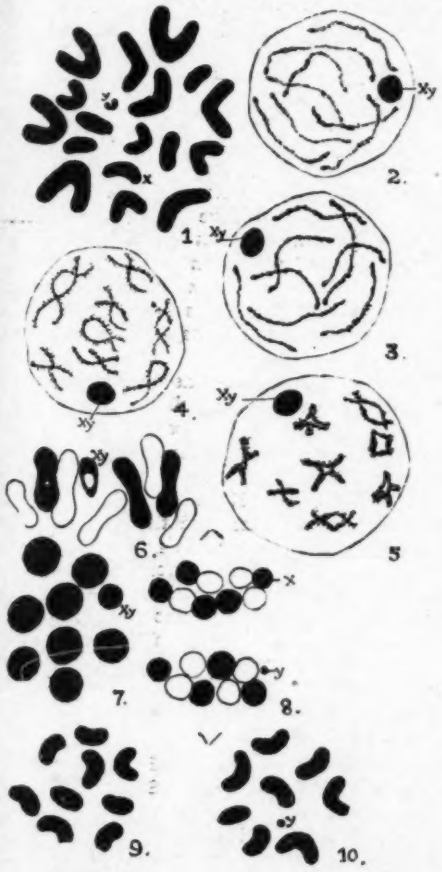
s: spermatogonium. o: oogonium. I: primary spermatocyte. II: secondary spermatocyte.

those reported for other species worked out so far. The present report gives an account of the structure and behaviour of the chromosomes during mitosis and meiosis in *Berosus indicus* collected from McPherson Lake, Allahabad. Testes from adult living males were fixed in Sanfelice for 6-12 hours and sections stained with gentian violet and Feulgen's stain were examined.

SPERMATOGONIA

The chromosome complement at spermatogonial metaphase shows 18 chromosomes (Fig. 1) which can be easily classified into

8 large, 9 medium and one small chromosome. The latter which lacks a homologue in the complement is supposed to be the *y*-chromosome. Despite its minute size, the *y* is visibly metacentric in nature with a clear constriction in the middle. The X is obviously one of the medium-sized chromosomes. The chromosomes



FIGS. 1–10. Chromosomes of *Berosus indicus* (× approx. 5,000). Fig. 1. Spermatogonial metaphase. Fig. 2. Zygotene stage showing deep y-stained sex chromosome mass. Fig. 3. Pachytene. Fig. 4. Diplotene. Fig. 5. Ealry diakinesis. Fig 6. First metaphase (side view). Fig. 7. The same (polar view). Fig. 8. Anaphase I. Fig. 9. Second metaphase, X-class. Fig. 10. The same, *y*-class.

according to their comparable shape and size fall into eight homologous pairs of autosomes and an unequal pair of sex chromosomes X and *y*. Of the total eight pairs of autosomes, six are metacentrics and two rod-shaped acrocentrics.

Meiosis

During prophase stage the X and *y* sex chromosomes appear as a single fused heteropycnotic mass lying near the periphery. On close examination, at early zygotene (Fig. 2) the homologous autosomal threads are observed lying close parallel to each other. The pachytene nucleus (Fig. 3) displays eight autosomal bivalent threads and a heteropycnotic sex chromosome mass. At late pachytene the autosomal threads bearing heteropycnotic knobs appear hairy owing to the presence of fine, faintly-stained, Feulgen-positive lamp-brush fibres. These fibres become somewhat more distinct at diplotene. At diplotene (Fig. 4) the autosomes have 1-2 chiasmata each according to their length. The early diakinetic autosomal bivalents (Fig. 5), though considerably condensed, also exhibit lamp-brush fibres, but they completely disappear at late diakinesis.

The first metaphase plate (Fig. 6) contains 9 bivalents of which eight are autosomal tetrads and one is a heteromorphic X-*y* complex of typical parachute form. The latter is clearly recognizable from the autosomes at this stage. The autosomes appear dumb-bell-shaped bodies except one which is ring-shaped. As observed in polar view (Fig. 7) the chromosomes are deeply-stained spherical bodies. At anaphase I the X and *y* chromosomes segregate migrating to the opposite poles of the spindle along with the autosomes (Fig. 8). The first division results in two types of secondary spermatocytes—one with 8 autosomes *plus* an X and the other with the same number of autosomes *plus* a *y* (Figs. 9 and 10).

The work was done in the Zoological Research Laboratories of Allahabad University, Allahabad. The author is grateful to Prof. M. D. L. Srivastava for his kind guidance and to Dr. A. P. Kapur, Zoological Survey of India, for identification of the material.

Division of Microbiology, Central Drug Research Institute, Lucknow, *April* 15, 1960. Uma Agarwal.

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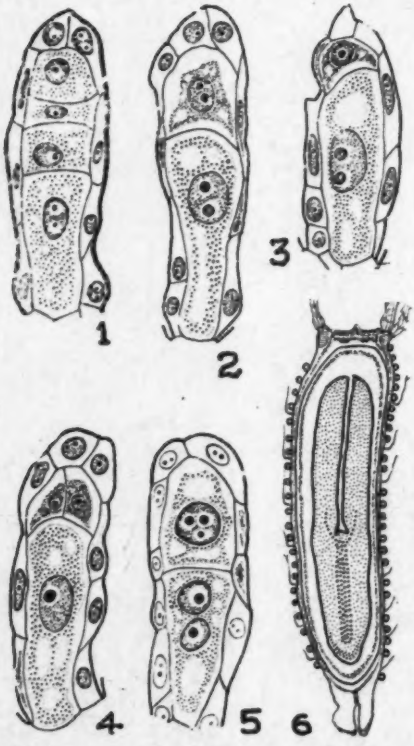
EMBRYO-SAC DEVELOPMENT IN *VERNONIA CINERASCENS* SCHULT. AND SEED DEVELOPMENT IN *V. CINEREA* LESS.

WHILE working on the embryology of *V. cinerascens* and *V. cinerea*, some interesting features were observed.

The development of the embryo-sac in different florets even in the same capitulum of *V. cinerascens* is of the Polygonum (Fig. 1) and Allium type. In the latter, micropylar dyad cell degenerates, the chalazal develops into the embryo-sac (Figs. 2 and 3). Sometimes the micropylar dyad may divide by a vertical wall resulting in a triad (Fig. 4). The two megaspores of the triad degenerate while the chalazal dyad develops into embryo-sac. In one case the chalazal dyad developed into a bi-nucleate embryo-sac, while the micropylar dyad continued in a healthy condition (Fig. 5).



FIGS. 1–6. *Vernonia cinerascens*. Fig. 1. Tetrad of megaspores. Figs. 2–3. Dyad cells, micropylar dyad degenerating. Fig. 4. Triad, micropylar megaspores degenerating. Fig. 5. Dyad, chalazal two-nucleate—*V. cinerea*. Fig. 6. L. S. achene, endosperm surrounding the embryo.

Although the pericarp and the pappus develop normally, seeds do not develop in *V. cinerascens*. Seed development has been studied in *V. cinerea* only. Embryo is straight, enveloped in minute endosperm, filling the pericarp (Fig. 6). Integument is almost completely liquidated; hence testa is not formed. Pericarp does not show any anatomical differentiation except its prominent outermost layer which becomes thick-walled—bearing achenical hairs and vesicular cells on its surface. Inner layers of the pericarp remain attached to it in a crushed state. Seeds of Compositæ are usually described as exalbuminous.[1–3] However, two layers and one or two layers of endosperm occur in *Rudbeckia bicolor* and *Tridax procumbens* respectively.[4,5] Fourmant and Rouzet[6] described a compressed *almost non-existent endosperm in Galactites tomentosa*.

Recently Deshpande[7] described non-endospermic seed in *Cæsulia axillaris* Roxb. Moreover, he makes a queer observation that it is the endothelium which stores food and simulates endosperm. This would really be very interesting if it were true. Nutritive and later protective functions of the endothelium are well-known but as far as we are aware, none so far has ascribed a storage function to endothelium. Our study further reveals that a scanty endosperm really exists. It is also felt that in some cases at least, the inner crushed layers of the pericarp have probably been mistaken for testa.[1–3]

Details of the work will be published elsewhere.

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Jaswant College,
Jodhpur, *April* 28, 1960.

1. Venkateswarlu, J. and Maheswari Devi, H., *Proc. Ind. Acad. Sci.*, 1955, **41**, 38.
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*6. Fourmant, P. S. and Rouzet, M., *Bull. Soc. Hist. Nat. Afrique/du Nord*, 1957, **48** (5/6), 307.
7. Deshpande, P. K., *Curr. Sci.*, 1960, **29** (2), 56.

* Not seen in original.

REVIEWS

Nuclear Magnetic Resonance. By John D. Roberts. (McGraw-Hill Book Company, Inc., N.Y.), 1959. Pp. 118. Price $ 6.00.

Extensive applications of N. M. R. Spectroscopy are being made to solving chemical problems and it has proved to be a powerful tool, especially in the hands of organic chemists. Since nuclear magnetic resonance is sensitive to environment in which a particular nucleus is located, structural information can be derived from a study of the n.m.r. spectra. Fine structures arising out of magnetic interaction and nuclear quadrupole relaxation effects are additional features in high resolution n.m.r. spectroscopy.

The book under review has been written with the organic chemist in mind and the presentation is therefore non-mathematical. Section I—Introduction is a delightful presentation of the basic principles of nuclear magnetic resonance. Numerous and attractive diagrams in colour decorate this section. The most important aspect is the so-called chemical shift which is of interest from the point of view of the chemist. This is dealt with in Section II. In Section III the fine structures arising out of spin-spin interactions are described. Section IV deals with n.m.r. and reaction kinetics. Section V provides a brief account of quadrupole relaxation effects and double resonance. Numerous applications from the field of organic chemistry have been set out. In Appendix A a simplified treatment of Bloch's equations is given.

The reviewer strongly recommends this book to all chemists who will find in it a powerful tool of recent origin explained in a lucid manner.

A. J.

Nuclear Science Series. (Published by the National Academy of Sciences, National Research Council, 2101, Constitution Avenue, Washington, D.C.).

Radiochemistry of Thorium. (NAS-NS 3004). Pp. 70. Price $ 0.75; *Fluorine, Chlorine, Bromine and Iodine* (NAS-NS 3005). Pp. 42. Price $ 0.50; *Americium and Curium* (NAS-NS 3006). Pp. 62. Price $ 0.75; *Chromium* (NAS-NS 3007). Pp. 34. Price $ 0.50; *Rhodium* (NAS-NS 3008). Pp. 32. Price $ 0.50; *Molybdenum* (NAS-NS 3009). Pp. 38. Price $ 0.50; *Barium, Calcium and Strontium* (NAS-NS 3010). Pp. 118. $ 1.25; *Zirconium and Hafnium* (NAS-NS 3011). Pp. 52. Price $ 0.50.

This series of monographs has grown out of the need for up-to-date compilations of radiochemical information and procedures and is brought out by the Sub-committee on Radiochemistry working under the Committee on Nuclear Science. The Atomic Energy Commission has sponsored the printing of the series.

In each monograph is included a table of isotopes with decay schemes, a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and finally, a collection of radiochemical procedures for the element as found in the literature.

The concise, clear and systematic information given in each of these monographs will be useful not only to the radiochemist but also to the research worker in other fields such as physics, biochemistry or medicine interested in radiochemical techniques.

The above monographs are available from the Office of the Technical Services, Department of Commerce, Washington 25 D.C.

Carnegie Institution of Washington. Year-Book 58. (July 1, 1958 to June 30, 1959), 1959. Pp. xi + 500. Price $ 1.00. (Paper bound).

In this annual publication, the various activities in which the Carnegie Institution is engaged in are set out for the period 1958-59. The departments run by the institution are the following:—The Mount Wilson and Palomar Observatories, Geophysical Laboratory, Department of Terrestrial Magnetism, Joint Committee on Image Tubes for Telescopes, Department of Plant Biology, Department of Embryology and Department of Genetics.

The Mount Wilson and Palomar Observatories, especially the latter one with the biggest telescope in the world, are engaged in both solar and stellar observations. Spectroscopic observations and magnetic field studies carried out during the year are described. Experimentation at high pressures and temperatures and petrological and phase relation studies occupy the major portion of the activities of the Geophysics Laboratory. Amongst the activities of

the Department of Terrestrial Magnetism, radio-astronomy occupies a principal place. The Biophysics Section under this Department is very actively engaged in fundamental problems connected with nucleo-proteins in the cells, particularly ribosomes (ribonucleo-protein particles). The Department of Plant Biology has engaged in biochemical investigations on chlorophyll and plant growth and climatology. Detailed results on numerous studies carried out during the year by the Departments of Embryology and Genetics are given. A bibliography of papers that appeared during the period is given at the end of the report from each department.

The publication will interest astronomers, geo-

A. J.

Window in the Sky. By Homer E. Newell, Jr. (McGraw Hill Book Co., 330, West 42nd St., New York 36, N.Y.), 1959. Pp. 118. Price $ 2.75.

The biggest window in the world is the open sky above us. The "spacious firmament on high" and the "spangled heavens" are seen through the atmosphere. Like the windowpane, the atmosphere appears at first glance to be completely transparent. But in fact it allows only a small part of the vast range of electromagnetic radiations which are being emitted constantly from the sun, the stars, and the atoms and molecules in space.

The optical telescope catches only a very small part of this immense gamut of electromagnetic wavelengths—the messengers from the depths of the universe—and the knowledge of the universe derived from optical studies is naturally incomplete. The great advances that have been made in recent years with radio telescopes, rocket borne equipment, artificial satellite studies, etc., have enlarged our horizon of understanding and new facts about the universe are emerging out.

This small book of a little more than 100 pages gives the story of the upper atmosphere of the earth, its composition and behaviour, and describes many of the interesting phenomena that occur at high altitudes.

It is fascinating reading from cover to cover.

A. S. G.

Heat and Thermodynamics. 5th Edition. By J. K. Roberts and A. R. Miller. (Blackie & Son Ltd., London W.C. 2; India: 103-5, Fort Street, Bombay), 1960. Pp. xx + 619. Price 45 *sh.*

This standard book on Heat and Thermodynamics by Prof. J. K. Roberts needs no introduction to graduate students for it has been a popular text-book in almost all the universities in India for nearly three decades. The popularity that the book has been enjoying is due to the lucid treatment of the subject both on the theoretical and the experimental side and the analytical discussion of the application of thermodynamics to physics, physical chemistry and engineering.

The fourth edition of this book, published in 1950, was completely revised by the second author, A. R. Miller, who brought it to what was then up-to-date by adding new chapters and recasting the older ones. Miller has kept the same end in view in preparing the fifth edition of the book, and new material has been added taking into account the important progress that has been made in the subject during the last ten years. Among the additions particular mention should be made to the article on cooling by adiabatic demagnetization and the one on Bunsen's ice calorimeter which has now become a high-precision apparatus for measurements of enthalpy.

This new edition which has been thoroughly revised and in which the references have been brought up-to-date will be welcome especially by the teachers of the subject. The printing and get-up of the book are of the high standard characteristic of the Blackie and Son's publications.

A. S. G.

The Indian Ephemeris and Nautical Almanac for the Year 1961. (Published by the Manager of Publications, Civil Lines, Delhi), 1960. Pp. xxviii + 448. Price Rs. 12·50 nP. or 19 *sh.* 6 *d.*

The present issue of the Ephemeris for 1961, which is the fourth in the series, is on the same lines as that for 1960 except for the addition of a few minor tables. The important change introduced in the issue for 1960 of the use of Ephemeris time instead of Universal time has naturally been continued here also, along with a note in the introduction explaining in greater detail the implications arising out of this replacement. The additions made to the issue of 1960 are indicated on pages v and vi of the Preface, where it is also mentioned that the table on circumstances of occulation has been omitted from this issue with the hope that it will be possible to present the information in an improved form in future years. As regards the tables giving advance information for the period 1st January to 21st March of the next year, more have been added in this issue than

in that for 1960. Thus on pages 424-26 are added five such tables, and this improvement is bound to be of help to indigenous almanac-makers.

The special phenomenon of the total eclipse of the sun on February 15, 1961, which is visible in India, except the southern and south-eastern parts, has been fully dealt with on pages 296-301 by tabulating all the essential data, giving an illustrative diagram, and adding special tables giving the local circumstances relating to India, and to certain important places in India. The same is true of the partial eclipse of the moon on March 2, 1961 visible in India.

We are glad to note that this Ephemeris is maintaining a steady improvement since its first publication relating to the year 1958, and also that the price of the publication has been reduced for the present issue. B. S. M.

The Wealth of India. *Industrial Products*—Part V (I-L). (The Publications Directorate, Council of Scientific and Industrial Research, New Delhi), 1960. Pp. xvi + 290. Price Rs. 30·00.

The Wealth of India or *A Dictionary of Indian Raw Materials and Industrial Products* is a comprehensive and authoritative publication undertaken by the Council of Scientific and Industrial Research, India, and is being issued in two series, one dealing with the raw materials and the other with the industrial products. Part IV of the second series was published in 1957. The volume under review, namely Part V, published during the current year, follows the pattern of the earlier ones and comprises 24 industries alphabetically coming under the letters I, J, K and L.

Iron and Steel industry is the most important in this part and covers nearly a fifth of the volume. This industry symbolizes the rapid growth that is taking place in the mechanized industrialisation of the country. "Khadi", on the other hand, which has come to be known as the 'Livery of Freedom', represents the most important cottage industry providing dignified labour for more than a million people in their cottages. The history and organized development of this industry since its revitalisation by Mahatma Gandhi have been described in proper perspective.

Another important article in this volume having a bearing on the vast agricultural population of the country is the one on Insecticides. The FAO (Food and Agricultural Organization of the United Nations) estimates the total annual loss of grain crops, all over the world, due to animal and insect pests at 33 million tons—sufficient to feed 150 million people for one year. The manufacture and use of chemical pesticides in India for plant protection and public health purposes, though of recent origin, are expanding rapidly. The quantity of pesticides used in the country in 1958 for crop protection was 21,890 tons costing 314 lakhs of rupees. The article includes informative tables on the properties and applications of several organic insecticides, fumigants, fungicides and weedicides.

The articles on Ivory, Jewellery, and Lapidary describing the traditional craftsmanship in these arts can be read with interest. Among the other important industries described are Jute mill industry, Leather and Locomotives.

While the usual high standard has been maintained in the production of this part so far as the contents and information are concerned, the same cannot be said of all the illustrations and plates. As a reference book this series of volumes is indispensable for educational and technical institutions and industries.

A. S. G.

The Geochemistry of Rare and Dispersed Chemical Elements in Soils. Second Edition. Revised and enlarged by A. P. Vinogradov. Translated from Russian. (Consultants Bureau, Incorporated in New York; India: Asia Publishing House, Bombay-1), 1959. Pp. 209. Price $ 9.50.

Geochemistry is a growing branch of the earth sciences which concerns itself with the distribution, migration, fixation, etc., of chemical elements on the surface of the earth. Russian contribution to this branch of science is quite considerable and this particular book will satisfy the expectations of many a scientist in the field who is conversant with the Russian works on Geochemistry and the standard of work expected of an eminent author like Vinogradov.

The scope of the book is restricted to the rare and dispersed chemical elements in soils and it deals with the physico-chemical properties of the individual rare elements, their occurrence and distribution in soils and rocks, and their role in the lives of plants, animals and humans.

The book is divided into 19 chapters out of which 13 chapters are devoted exclusively for giving the results of the analyses carried out by the author and his colleagues in the Vernadskii Institute of Geochemistry and Analytical Chemistry in U.S.S.R., and the conclusions they draw on this basis. These special chapters on

the individual rare elements, contain a number of tables, where the soils analysed and the limits of the contents of the rare elements along with their average content, are given. Besides the results of the author's own analyses, the investigations of the scientists in other countries of the world and their results are also incorporated in several comprehensive tables.

The publishers having introduced this book to the English speaking world could also arrange to bring out the publication giving the Soviet analytical techniques for the determination of rare and dispersed elements in soils. The book under review, by the very nature of its scope, cannot devote full attention to these methods although the author gives the general outlines of all the methods used by him in Chapter 2.

More than 20 complete soil profiles from different soil zones of the Eastern European Plain are examined in this volume and one chapter is completely devoted to a brief lithologic, mineralogic and chemical compositions of the covering sediments of the Plain.

The author's suggestion to undertake the mapping of the Russian soils according to their content of rare and dispersed elements can be followed with quite substantial results in our country also. In fact the presence of very few references for analytical results from India in these comprehensive tables covering the whole world indicate also the amount of work that can be undertaken in this very profitable branch of science in our country which is out on its campaign for improving agriculture, water-supply, public health, etc.

C. SRINIVASAN.

Modern Co-ordination Chemistry: Principles and Methods. Edited by J. Lewis and R. G. Wilkins. (Interscience Publishers, New York and London), 1960. Pp. xvi + 487. Price $ 12.50.

Although modern theory on co-ordination compounds could be traced to the pioneering investigations of Alfred Werner (1893-1919), important developments in co-ordination chemistry have taken place only during the last twenty years. An effective study in this rapidly advancing field requires a comprehensive knowledge of a variety of physical methods. The book under review contains authoritative contributions by a young team of active workers on recent applications of a variety of physico-chemical techniques for the study of different aspects of co-ordination chemistry.

The subjects presented in the book are: the thermodynamics of metal ion complex formation in solution (F. J. C. Rossotti), the reaction rates of transitional metal complexes (D. R. Stranks), the isomerism of compounds (R. G. Wilkins and M. J. G. Williams), the visible and ultra-violet spectra of transitional metal complexes (F. A. Cotton) and magnetochemistry of complex compounds (B. N. Figgins and J. Lewis). Each chapter presents systematically the theory, experimental techniques and discussion on recent developments on the subject concerned. Ample recent references (up to 1958) are provided at the end of each chapter to make the reader's task of investigating any particular aspect of the subject easier.

The chapter by Rossotti familiarises Jannik Bjerrum's work on stepwise complex formation in solution and the subsequent developments. The author has brought out the difficulties, short-comings, beliefs and have pointed out means and reasons for rectification. In his familiar field on kinetics, Stranks has covered a variety of experimental techniques and discussed solvolysis, substitution and oxidation-reduction processes. Crystal field and ligand field theories are applied to elucidate the nature of electronic transitions by Dunn. The contribution on infra-red spectra by Cotton is an excellent introduction for the beginners and a valuable recent review for the specialists in the field. Other chapters are also excellent monographs dealing with the modern applications. The Editors have done a valuable service by introducing uniformity in nomenclatures and symbols throughout the book. A metal-ligand index is also separately provided at the end of the book.

The reviewer strongly feels that the book will be of immense use particularly to those who are engaged in research on the subject, since it enables in assessing the applicability of a particular technique for the problems they usually face. The book is a valuable addition on the vital subject of co-ordination chemistry.

C. C. P.

The Chemistry of Natural Products, Vol. IV. *The Natural Pigments.* By K. W. Bentley. (Interscience Publishers, Inc., New York), 1960. Pp. vii + 306. Price $ 5.00.

The texts in this series are written for the use of the undergraduate students studying the chemistry of natural products, who find a very limited treatment given in general text-books and have difficulty in choosing the important

topics from the comprehensive monographs. The book under review is divided into twelve chapters. The first five chapters deal with the pyran pigments comprising flavones and flavonols, anthocyanins and anthocyanidins, xanthones rottlerin, brazilin and hematoxylin. The next four chapters are concerned with the pyrrole pigments, namely, the porphyrins, chlorophylls, the bile pigments and prodigiosin. The later chapters deal with the pterins, quinonoid and finally the polyene pigments. Each chapter ends with a useful list of references and a subject index is provided at the end of the book. The author has given an account of the degradative evidence for structure elucidation of various pigments and has described the method adopted for their syntheses wherever possible. The text is amply illustrated by hand-drawn structural formulæ on the right-hand pages only and this should be of great help to students. The reviewer however deprecates the unwieldy use of Roman numerals to refer to the formulæ. This restricts the speed of reading comprehension to a marked degree. The book is well written, but suffers to some extent from an uneven choice of the subject-matter. It is not known why some chemical classes like quinoxaline derivatives, *e.g.*, riboflavin ; phenoxazines, *e.g.*, xanthommatin ; diarylmethanes, *e.g.*, curcumin ; and indole derivatives, *e.g.*, indigo, have been omitted in the text. A discussion of the structures of vitamin B_{12} and vitamin K might have well been included in the chapters on pyrrole and quinonoid pigments.

There are several minor errors in the book. Formula XVII (p. 3), XXV should be XXXV (p. 6, line 28), LXI (p. 11), $C_{15}H_{11}O_7$ for quercetin (p. 10), karmala for kamala (pp. 58 and 304), astromentin for atromentin (p. 188), p. 483 for p. 477 (p. 232, ref. 25), tetraacetyl for tetraacetyl dihydro (p. 214), 1956 for 1950 (p. 235, res. 62 and 63), bromotetraacetyl (p. 302), daidzein has no reference on p. 29 (p. 303), dihidro for dihydro (p. 90, line 26). On p. 216, line 1 should read "Erythroaphin-*fb* on treatment with ammonia and further oxidation affords diaminoerythroaphin-*fb*". On p. 216 line 21, the catalyst used in Thiele acetylation was perchloric acid and not sulphuric acid. On p. 184, line 13, *leuco* perezone triacetate was ozonized and not perezone. Physical methods such as ultra-violet and infra-red spectra are increasingly employed in structure determinations and discussions of these methods at relevant places would have increased the value of the book. Since the only important book on natural colouring matters by Mayer and Cook published in 1943 is fast becoming out of date, a comprehensive monograph on this subject would be greatly welcomed by all organic chemists.

B. S. Joshi.

Antibiotics Annual—1959-60. By Henry Welch and Felix Marti-Ibanez. (Antibiotica, Inc., New York, N.Y.), 1960. Pp. xvii + 1034. Price $ 15.00.

This is the record of the Seventh Annual Symposium on Antibiotics held on November 4, 5 and 6, 1959, in Washington, D.C., sponsored by "Antibiotics and Chemotherapy" and "Antibiotic Medicine and Clinical Therapy". It is said that papers have been received from twenty-two foreign countries, but the monopoly is held by USA still. The proceedings contain 150 papers which were presented out of the 278 abstracts received. Besides reports on the well-known antibiotics, there are papers on the newer ones like colistin, aspartocin, fervenulin, streptozotocin, rifomycin, paromomycin, diazomycins, etc. There seems to be considerable activity around new "Synthetic penicllins" from 6-amino-penicillinic acid, and one of these, a methyl homologue of penicillin V seems to offer promise as better than its parent. Amphotericin has emerged as a very useful antifungal antibiotic and more interesting is the resurrection of griseofulvin as valuable for treating dermatomycosis and other superficial mycosis by oral medication. The articles by Dubos "Tyrothricin, gramicidin and tyrothricin, twenty years after" reinforces the unheard cry of the reviewer that the science of antibiotics is suffering from the usefulness of the antibiotics and their commercial exploitation. As Dubos says, "Nature is a coquette, likely to make fools of scientists who pretend to talk in her name or to be wise about her ways" ; but her coquettry can be mastered by deep scientific studies and not by making money out of it. There are a number of papers on refining and improving the methods of testing ; it seems to be in tune with the times that automation in assays introducing electronic computors and punch cards is being tried. The first five papers relate to the "challenge of new drugs in medicine, in pharmaceutical industry, to the clinical investigator, to the Food and Drug Administration, and to the practising physician. It is rather disheartening to read the following : "Unfortunately, at the present time, medical education seems to end largely with the awarding of the degree. After that the clinical training is acquired from preceptors, but throughout most of the physician's career his education about new drugs is from the

literature provided by the manufacturers or, perhaps, even more so, directly from their representatives by word of mouth". In the case of the drugs, as in no other commodity, the motivating considerations must be the welfare and benefit of society, and not simply the common lure of the market place—financial gain" correctly says the Medical Director of Food and Drug Administration. There are two panel discussions, and one of these covers excellently the sensitization to antibiotics, which every clinician handling antibiotics should know about. To the reviewer, this series has been serving as the annual programme of education on antibiotics as regards their effects and therapeutic potentialities. The Annuals have taken their place along with the increasing number of the other "annual reviews", to save the researchers from burning themselves out trying to cope with the torrential flow of literature.

K. GANAPATHI.

The Balkan Lake Ohrid and its Living World. By S. Stankovic. (Monographiæ Biologicæ, Vol. IX. Uitgeverij Dr. W. J. Junk. Den Haag), 1960. Pp. 357. Price *f.* 35.

Tectonic lakes, which are formed primarily by the mountain-producing forces of the earth, are of considerable interest biogeographically, on account of their uninterrupted existence from very remote times and the abundance of their endemic fauna. Lake Tanganyika and Lake Baikal are well known examples of such ancient Lakes.

The book under review is a monograph on another very interesting tectonic lake, Lake Ohrid, which is situated in the western part of the Balkan peninsula on the Yugoslav-Albanian border. Till half a century ago the very existence of this lake was almost unknown, and organised research was commenced only after the first World War. The results of the investigations carried out to-date are critically and ably presented by Prof. Stankovic. The book is well documented with facts, figures and excellent illustrations. There is an extensive bibliography of about seventeen pages. The main theme of the book is the biogeographical analysis of the lake. The origin, history and striking endemism and evolution of fauna of this lake, which had its origin about the end of Pliocene, are discussed in detail.

The study of the endemisms of this lake has proved significant for understanding the wealth of cave and underground fauna in the Adriatic coast, which has puzzled zoologists for a long time. The Lake Ohrid, situated in the Dinaric region, the narrow calcareous stretch along the Adriatic coast, has played the role of a gigantic reservoir, where numerous ancient faunistic elements found refuge, with a few of their counterparts seeking shelter in the neighbouring underground caves and spaces.

The biogeographical picture of this lake with its high-lights of endemisms is presented against a background of physiography and detailed ecological analysis of the lake. This synthesis of physiography, ecology, and biogeography is an outstanding feature of the monograph and has been ably carried out by Prof. Stankovic. To complete the picture of the lake, the penultimate chapter gives an appraisal of the fishery of the lake, and the last chapter outlines the development of the Ohrid Biological Station and its achievements and potentialities.

We would like to congratulate the author and editors on planning and publishing this excellent monograph. The format of the book leaves nothing to be desired. We hope to see further publications on this unique lake of Europe, including the dynamics of its ecosystem and the cytogenetical aspects of speciation of organisms in the lake.

R. V. SESHAIYA.

Books Received

An Introduction to the Chemistry of Heterocyclic Compounds. By R. M. Acheson. (Interscience Pub., New York), 1960. Pp. xiv + 342. Price $ 5.00.

Frozen Free Radicals. By G. J. Minkoff. Interscience Pub., New York), 1960. Pp. ix + 148. Price $ 5.00.

The Applications of Elliptic Functions. By Alfred George Greenhill. (Dover Publications, New York), 1960. Pp. xi + 357. Price $ 1.75.

Differential Equations for Engineers. By Philip Franklin. (Dover Publications, New York), 1960. Pp. vii + 299. Price $ 1.65.

Co-ordinate Geometry. By L. P. Eisenhart. (Dover Publications, New York), 1960. Pp. x + 297. Price $ 1.65.

Algebras and their Arithmetics. By L. E. Dickson. (Dover Publications, New York), 1960. Pp. xii + 241. Price $ 1.35.

Statistics Manual. By Edwin L. Crow, F. A. Davis and M. W. Maxfield. (Dover Publications, New York), 1960. Pp. xvii + 288. Price $ 1.55.

Inorganic Chemistry. By R. B. Heslop and P. L. Robinson. (Elsevier Publishing Co., D. Van Nostrand Co., Ltd., 358, Kensington, London W. 14), 1960. Pp. vii + 558. Price 45 *sh.*

Viscoelasticity-Phenomenological Aspects. Edited by J. T. Bergen. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. x + 150. Price $ 6.00.

Kinetics of Electrode Processes and Null Points of Metals. By L. I. Antropov. (Council of Scientific and Industrial Research, New Delhi-1), 1960. Pp. x + 94. Price Rs. 5·00.

Medicinal Chemistry. Second Edition. Edited by Alfred Burger. (Interscience Pub., New York), 1960. Pp. xiii + 1243. Price $ 37.50.

Chemical Instrumentation. By H. A. Strobel. (Addison Wesley Publishing Co. Inc., Reading, Massachusetts, U.S.A.), 1960. Pp. xviii + 653. Price $ 9.75.

Royal Society Mathematical Tables-5—Representations of Primes by Quadratic Forms. Edited by J. C. P. Miller. (Cambridge University Press, London, N.W. 1), 1960. Pp. xxiv + 135. Price 45 *sh.*

Radioactivity for Pharmaceutical and Allied Research Laboratories. Edited by Abraham Edelmann. (Academic Press, New York; India: Asia Publishing House. Bombay-1), 1960. Pp. xii + 171. Price $ 6.00.

A Bibliography of Indology, Vol. I.—*Indian Anthropology.* Edited by D. L. Banerjee and A. K. Ohdedar. (The Librarian, National Library, Calcutta-27), 1960. Pp. xi + 290. Price Rs. 5·00.

Introduction to Statistical Thermodynamics. By T. L. Hill. (Addison Wesley Publishing Co. Inc., Reading, Massachusetts, U.S.A.), 1960. Pp. xiv + 508. Price $ 9.75.

SCIENCE NOTES AND NEWS

Holcocera pulverea Meyr. as a Pest of Tamarind

Sri. C. N. Oommen, Division of Entomology, Agricultural College, Vellayani, Kerala, reports that the caterpillar *Holcocera pulverea* Meyr. which has hitherto been known only as a predator, *e.g.*, on the lac insect *Laccifer (Tachardia) lacca* Kerr. and on coccids has been found to occur as a pest of tamarind fruits (*Tamarindus indica*).

Myllocerus viridanus F. (Curculionidae: Coleoptera) a New Pest of Papaya in South India

Messrs S. Jayaraj, A. Abdul Kareem and P. P. Vasudeva Menon from Coimbatore, report the occurrence of the common weevil, *Myllocerus viridanus* F. as a pest of papaya, skeletonizing the leaves, and some times responsible for premature death of infected plants.

Award of Research Degree

Annamalai University has awarded the Ph.D. Degree in Chemistry to Shri M. Seshapathi Rao Naidu for his thesis "Preparation of some *cis*-*trans* isomers of α, β-unsaturated sulphones and a study of their configuration by physico-chemical methods".

Birbal Sahni Institute of Palaeobotany, Lucknow

The thirteenth annual scientific meeting of the Palæobotanical Society will be held at the Institute's premises on the 21st and 22nd of January 1961. The programme that has been arranged includes lectures, reading of papers and discussions. Palæobotanists from all over India are expected to participate.

The Institute of Physics and the Physical Society—Conference on Irreversibility and Statistical Mechanics

The Institute announces that it is arranging a conference on statistical mechanics (with special reference to irreversibility). It will be held at Queen Mary College, London, on Monday and Tuesday, 19th and 20th December 1960. A full programme has already been arranged. The topics include the general theory of irreversibility, random processes, liquids (theory and experiment) and irreversibility in gases and in plasma. Further information and preliminary programmes can be obtained from the Secretary, The Institute of Physics and The Physical Society, 47, Belgrave Square, London, S.W. 1.

Sixth Congress on Theoretical and Applied Mechanics

The Sixth Congress on Theoretical and Applied Mechanics will be held under the Presidentship of Dr. A. N. Khosla, from December 23 to 26, 1960, at the Delhi University, Delhi, India.

Research papers may be contributed on any of the following topics: (1) Elasticity, Plasticity

and Rheology; (2) Fluid Mechanics (Aerodynamics and Hydrodynamics); (3) Mechanics of Solids (Ballistics, Vibration, Friction and Lubrication); (4) Statistical Mechanics, Thermodynamics and Heat Transfer; (5) Mathematics of Physics, Statistics and Computation; (6) Experimental Techniques. There will be invited addresses of about a half-hour duration on special topics. Along with the Sixth Congress, a Symposium on High Speed Computation Methods and Machines will be held under the joint sponsorship of The Indian Society of Theoretical and Applied Mechanics and The IBM International.

Application forms for Registrations and other information may be obtained from the Secretary-Treasurer, Dr. B. R. Seth, Indian Institute of Technology, Kharaghpur, India.

Seventh Commonwealth Entomological Conference

The Seventh Commonwealth Entomological Conference was held in London from 6th to 15th July 1960. Nearly 50 delegates from most of the countries of the Commonwealth attended.

Among the subjects discussed at the Conference were the following:—

(*i*) Recent developments in insecticides for crop protection; (*ii*) Biological control of insects and weeds; (*iii*) Recent investigations on timber-boring beetles; (*iv*) The utilization of pathogenic organisms in the control of insect pests; (*v*) Recent research on locusts and their control; (*vi*) Developments in the study of plant viruses and their vectors and their bearing on control measures.

In addition to the reading of papers, several excursions were organised. These included visits to the Rothamstead Experimental Station, Harpenden; Pest Infestation Laboratory, Slough; East Malling Research Station, East Malling.

Automatic Language Translator

The United States Air Force Research Department has developed an electronic translator capable of turning Russian into English at the rate of 35 words a second. The heart of the device is a "photoscopic memory" invented by G. W. King of the IBM Research Centre.

A transparent disk only 10" in diameter, this dictionary unit can store 550,000 Russian-English words in an area the size of a postcard. They appear around the edge of the disk in concentric tracks of binary code. As a Russian word is fed into the translator *via* a punched tape, it is "read" by the machine and converted into electrical signals. These are matched in a lightning dictionary drill with the coded equivalents on the glass disk. The English translation is transmitted over an electric typewriter. Any word in the dictionary disk can be located by the machine in less than 1/300 sec. The English output is "no literary masterpiece" since translation at this point is on a word-for-word basis. However, the machine gives a very good idea of the general content of a Russian article—even though it ignores many of the grammar rules.

Vegetative Propagation of *Hevea brasiliensis* by Cuttings

In a talk at the Natural Rubber Research Conference in Kuala Lumpur, G. H. Tinley, of the Rubber Research Institute of Malaya, described a method of growing high yield rubber trees from cuttings which may, if the experimental work is successful, be a great help in increasing latex production.

He explained that though cuttings from young seedlings root easily cuttings from mature bud-grafted trees, of proven high yield, are much difficult to root. The R.R.I. had been able to take a stage further earlier experiments in rooting cuttings and had developed a technique which is so far the most promising method of producing clones of Hevea on their own roots. Although at present only certain clones strike with good success experiments are in progress which, it is hoped, will assist in the rooting of the remaining clones.

It has been found that leafy softwood cuttings are the easiest to root. In the R.R.I. experiments the cuttings are placed in specially prepared beds in a "mist propagation frame"—the treatment includes spraying with water through atomisers for twelve hours every day. After five to nine weeks they are ready for hardening off and the misting is gradually reduced.

Several hundreds of rooted clonal cuttings have been hardened and planted in a nursery and in the field for observation, as stocks for future bud-grafting, and for transplanting experiments. Growth of many of the cuttings is very promising.

New Hypothesis on Fall of Tungus Meteorite

Academician Vasily Fesenkov, a Soviet specialist on meteorites, has suggested that the famous Tungus meteorite of 1908 was a case of collision of a comet with the earth—the only case recorded in human history. Fesenkov corroborates this hypothesis by new scientific

observations carried out in the area of the fall of the meteorite in 1958-60, as well as by data of an international questionnaire in which observatories of various countries took part.

The fall of the Tungus meteorite, one of the biggest in world history, was recorded in the area of Vanovara, Siberia, on June 30, 1908. The data available indicate that its total mass was tremendous: the high heat part alone which remained after the explosion weighed an estimated 1,000,000 tons. The primary cosmic energy was estimated approximately to be 10^{28} erg which is several times more than the energy of the world's second largest Sikhote-Aline meteorite.

Fesenkov asserts that this cosmic body could not be an ordinary meteorite if only because it moved around the sun in the opposite direction (it will be recalled that there are no meteorites with a reverse orbital movement around the sun). The destructive effect of the Tungus meteorite which caused exceedingly strong air waves also attests to its comet rather than meteorite origin.

High Vacuum High Temperature X-Ray Camera

A camera suitable for the examination of reactive metals such as titanium and zirconium up to temperatures of 1000° C. in a vacuum better than 1×10^{-6} mm. of mercury has been designed specially for studying β-α transformation in Ti and Zr alloys. The camera is equally suitable for a variety of other problems.

Existing types of high temperature X-ray cameras become unsuitable for such applications because of specimen contamination introduced by the relatively poor vacua attainable and the difficulties of outgassing the camera interior, particularly the furnace assembly. Essential features of the new design are the construction of the camera in glass and the use of the radiant heater situated outside the camera. The latter eliminates contamination due to the conventional furnace assembly within the instrument while the clean smooth interior walls and use of sheet specimens simplify the outgassing procedure.—*J. Sci. Instr.*, 1960, 37, 273.

Acoustic Thermometer

The Radiophysical Laboratory of the Soviet Academy's Institute of Atmospheric Physics has developed a method in which acoustic techniques are used to measure air temperature in the stratosphere. A sound source and two microphones of special design are used in the device. A controlled pulse of acoustic energy is emitted by the sound source, and the propagation time is measured by a circuit associated with the two microphones. The device has been successfully tested in a balloon flight to more than 20-mile altitudes, where non-thermal radiation and inefficient instrument-to-air heat exchange interfere with conventional thermometric readings. Further, the device can record rapid changes in thermal gradients induced by turbulence or layering. —*Soviet News.*

Neutron Physics Symposia

Two scientific symposia, one on "inelastic scattering of neutrons" and the other on "pile neutron research in physics," will be held by the International Atomic Energy Agency (IAEA) in Vienna during the current month, October 1960.

Research in the field of inelastic scattering of neutrons has developed greatly in the last few years in many countries. The purpose of the research in which the neutrons exchange energy with the thermal vibrations of solids, liquids and molecules, is to gain further knowledge about the properties of the latter and to investigate the role which thermal atomic vibrations in moderators play in the behaviour of nuclear reactors.

The discussions in this symposium will be on various aspects of general theory; methods of neutron spectrometry; problems of inelastic scattering of neutrons in solids, liquids and molecules; scattering by cold moderators and cooling of neutrons; neutron spectra; a special session will be devoted to water being one of the most widely used moderators in reactors.

The symposium on pile neutron research has been organized to provide an international forum for the exchange of information and experience gained in many countries of the world in the use of research reactors which will be of great value to all the participants and especially to those who only now have started or plan to start pile neutron physics programs with nuclear reactors.

Papers will be presented on various aspects of pile neutron research in physics; pulsed reactors; special apparatus; nuclear physics research with pile neutrons; solid and liquid state physics research with pile neutrons.

The proceedings of both the symposia will be published by IAEA.

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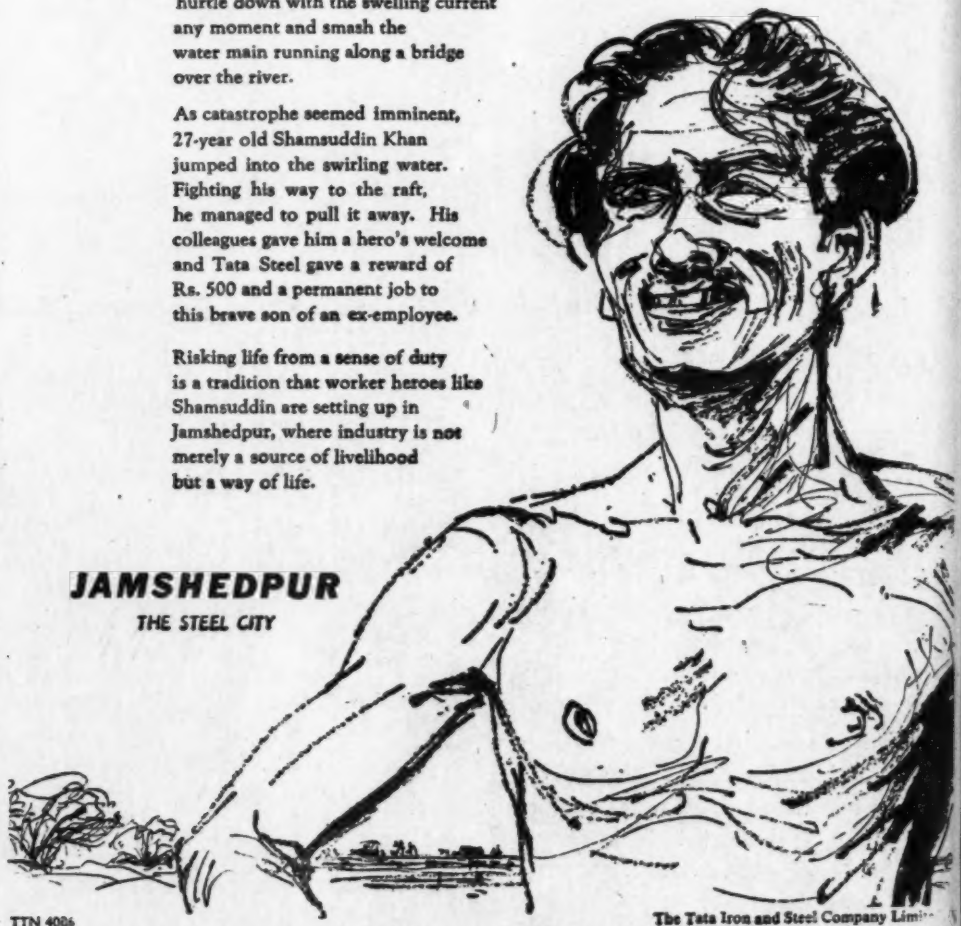

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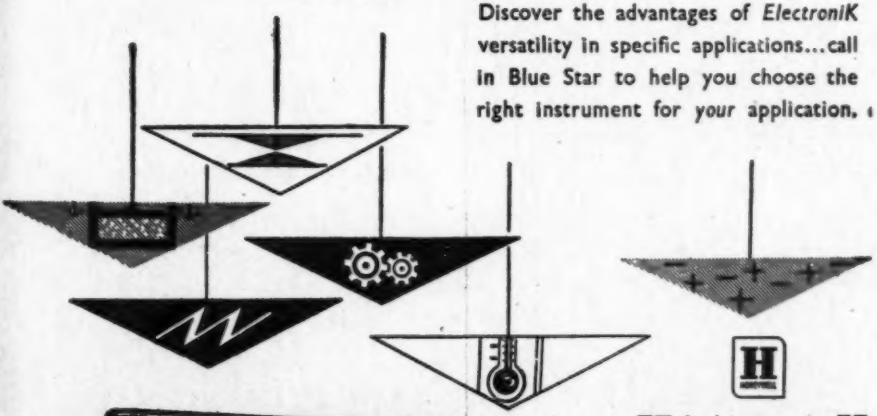

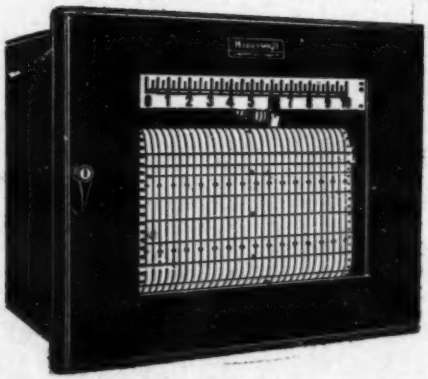

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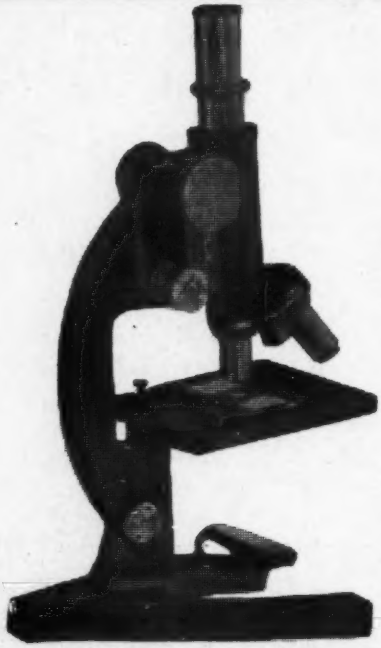

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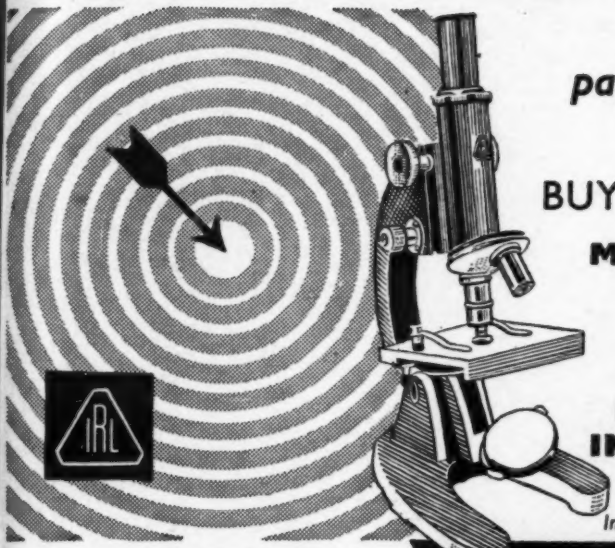

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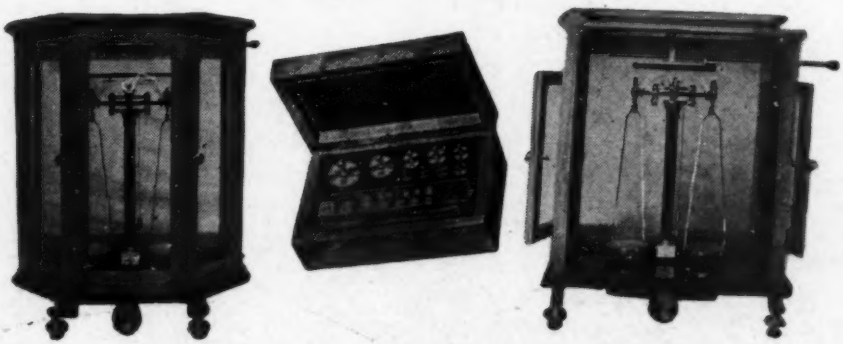

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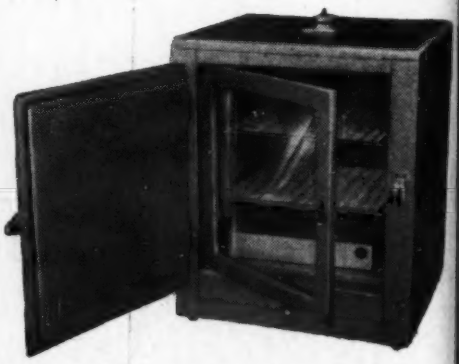

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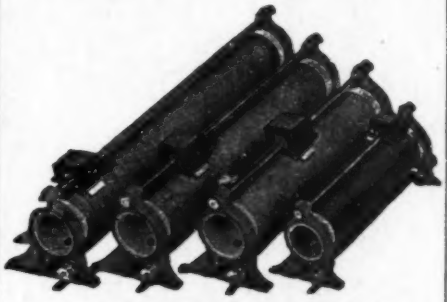

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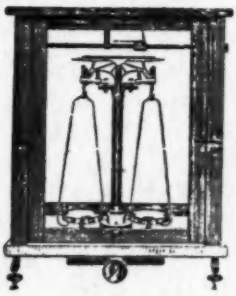

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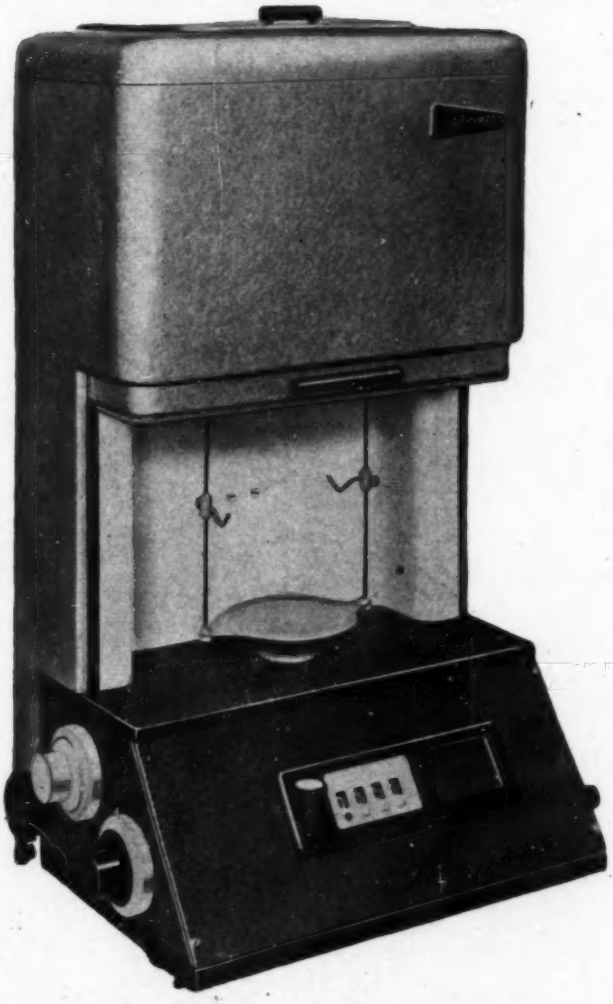

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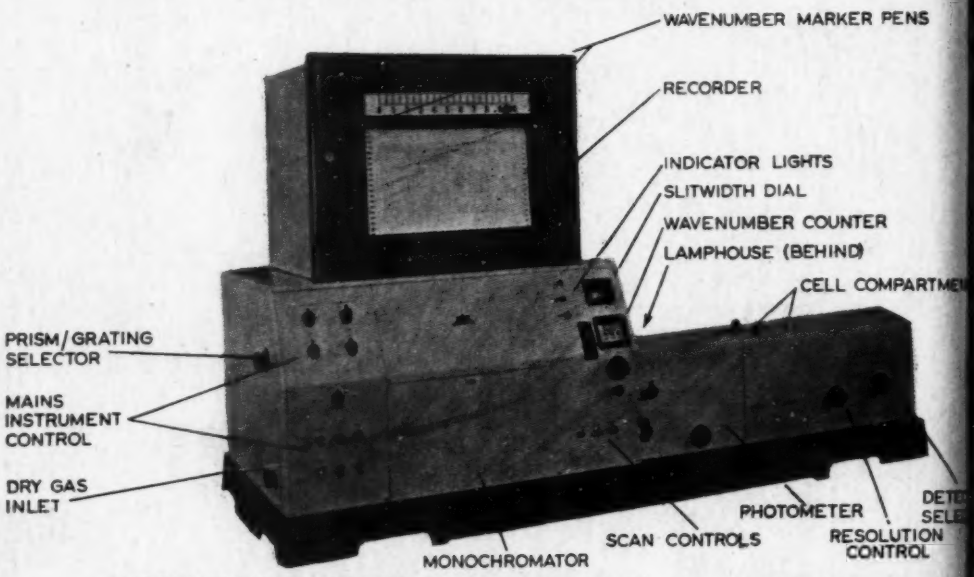

AUTOMATICALLY RECORDS TRANSMITTANCE OR ABSORBENCE ON A LINEAR WAVE-NUMBER SCALE IN THE RANGE FROM 54,000 $cm.^{-1}$ (186 $m\mu$) IN THE ULTRA-VIOLET TO 2,800 $cm.^{-1}$ (3·6 $m\mu$) IN THE NEAR INFRA-RED

Careful thought skilfully applied at all stages of design and production and strict observance of correct physical principles—these are the facts which guarantee the top-level performance of the SP 700 SPECTROPHOTOMETER. Resolution, sensitivity, stray light factor—all of the highest order. To these must be added maximum flexibility and ease and speed in use. A glance at the specification will convince the spectroscopist that only the UNICAM SP 700 offers all the features required at a highly competitive price.

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